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## TURRET DECK STEAMERS.

IN the year 1893, the first of a new type of cargo steamers was launched at the yards of William Doxford & Sons, Sunderland, England, which attracted much attention on account of striking novelties of its design and construction.

In a general way it resembled the whaleback steamers, of which several had by that time been built, and indeed it might have been called a compromise between the whaleback and the ordinary type of cargo steamer. The whaleback was designed with a view to reducing the dead weight of a ship relatively to her cargo carrying capacity, and introduced various structural features which, while they reduced the weight, added to the strength of the vessel. To this end the bulwarks were cut away and the side plating was carried round inboard and across the hull to form a stiff steel deck, which was elliptical in cross section and of course added immensely to the longitudinal strength of the ship. The dead wood was cut away as far as possible, and the bow was formed without any distinct cutwater, being what is known as "spoon-shaped," projecting forward far beyond the water line.

The whalebacks proved to be very economical boats, carrying large cargoes upon a small consumption of fuel. They were originally designed for service on the great lakes, and it is here that they have done their best work. For deep sea traffic they were not so well adapted, especially in heavy weather, though the defects of such boats as the Wetmore, which was lost on the Pacific coast, have been remedied in the later vessels.

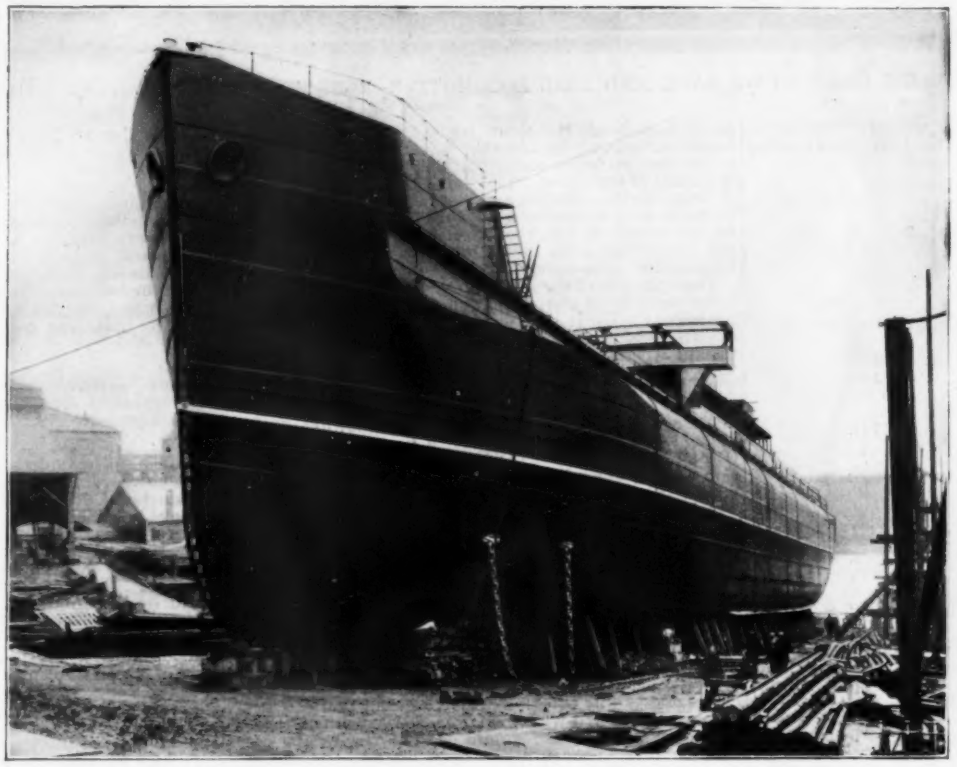
The turret deck ships, one of the latest of which forms the subject of our illustrations, were designed to embody the best features of the whaleback and the ordinary cargo steamer. They appear to be giving satisfaction, as may be judged from the fact that about three dozen of them are now afloat, although the type is only three years old. The average tonnage of the thirty-one ships built by Messrs. Doxford & Sons is 4,300 tons, and they are now at work upon a ship of 6,000 tons, and two others, larger yet, which will be 400 feet long.

By reference to our illustrations, for which we are indebted to the builders, it will be seen that the side plating of these ships is rounded over with an easy curve, as in the whalebacks, but that instead of being carried clear across to form a deck, it is rounded up with a return curve to the level of the upper deck, which is comparatively narrow, and extends flush and without any shear throughout the whole length of the ship. A cross section of the upper portion of the ship would present the appearance of a pair of rounded Z bars, all the advantages of structural stiffness which are claimed for Z bar shapes being gained by this arrangement. This enables the designer to dispense with much of the interior stiffening which is necessary in the ordinary cargo boat, and the holds are unusually free from decks and other obstructions to the free handling and stowage of cargo. Some of these odd looking boats have carried curious cargoes, such as locomotives, on the hatchways, large boilers and engines in the holds, and deck loads of timber stowed in the turret ways. Incidentally it may be mentioned that the turret ways are effective in checking the tendency to roll in a beam sea, as the water lodges in the hollow of the turret and by its weight reduces the angle of roll. How far the aim of the builders, which was "to produce a ship which would have a maximum carrying capacity on a minimum net register combined with light draught," was realized, is shown in the figures of the first boat of this type, the Turret, which was built to carry 3,200 tons on a net register of about 1,262 tons and a draught of 18 feet.

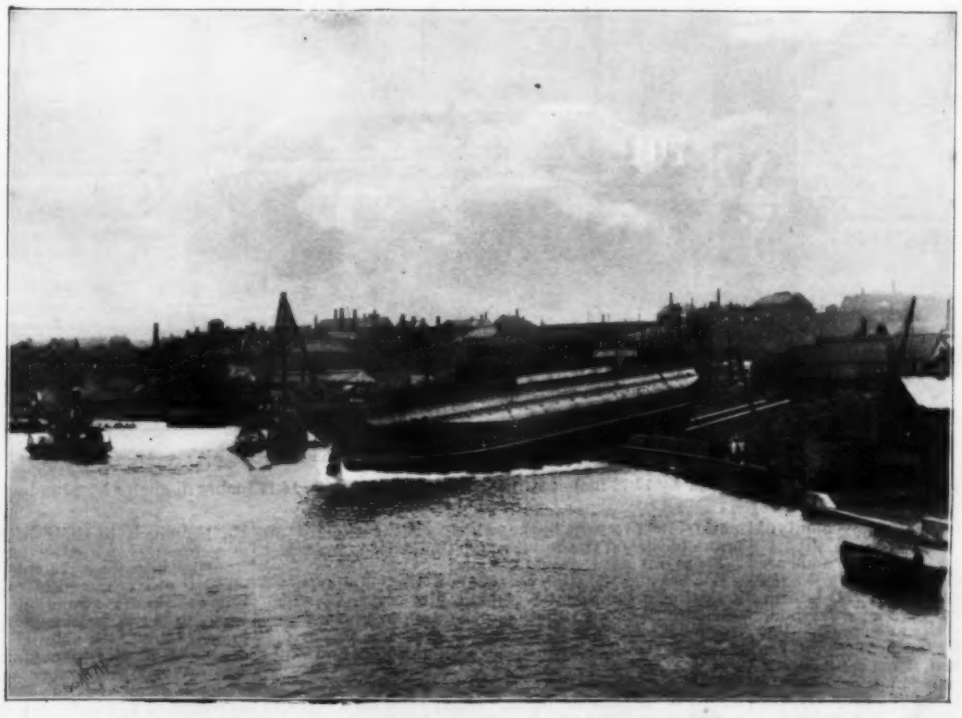
The turret decker is provided with a short forecastle deck, and as the turret ways do not extend to the bow, these ships have a high freeboard forward, and should make good weather when traveling head to sea. The latest of these vessels are built up with "joggled" plating, a system which was introduced by Messrs. Doxford, and is being extensively adopted in shipyards on the northeast coast of England and on the Continent. The plates are lap-jointed and "joggled;" that is to say, the alternate plates are rolled with a lip on each edge which covers the edges of the adjacent plates. This arrangement obviates the troublesome necessity for packing between the frames and the plating.

In the face of the fact that these curious ships have proved very successful, being both seaworthy and profitable, it seems perhaps a little ungracious to criticise their appearance; but they certainly suffer by comparison with the normal type of ship, with its graceful shear and its long unbroken lines from stem to stern.

However, this age is nothing if not utilitarian, so that we may look for more turret deckers in numbers proportionate to their profitableness.



TURRET DECK STEAMER ON THE STOCKS, SHOWING STEM AND "JOGGLED" PLATING.



THE LAUNCH OF A TURRET DECK STEAMER.

## A WRAPPING MACHINE.

A MACHINE, called the automatic newspaper wrapper, is a late invention, says Popular Science News. The wrapping paper is fed from a large roll on a revolving cylinder, passing over a series of smaller rolls to the wrapping chamber. The newspaper to be wrapped is fed from the top of this chamber through a wide slot and down an inclined plane onto the wrapper. As soon as it strikes the slowly moving wrapper sheet, little steel arms come up and engage the paper, and, by a lightning-like movement, give it and the wrapper the three folds necessary, while at the same moment a paste brush rises from a paste receptacle on the side and moves laterally across the wrapper at the proper point, and simultaneously a knife descends and cuts the wrapper, while arms give the finishing turn which presses down the pasted flap, and an injector discharges the neatly wrapped paper into a receptacle. All this is done in a minute fraction of the time taken to describe it. The machine is said to have a capacity of one thousand papers per hour.

PROF. Hugo Gylden, of Stockholm, the celebrated astronomer, died recently in his seventy-fifth year.

## RACK RAIL LOCOMOTIVES—BOSNIA AND HERZEGOVINA STATE RAILWAYS.

IN the accompanying illustrations will be found a general view and details of two narrow gage and mountain locomotives which figured in the section devoted to railroad interests of the Hungarian Millennial Exhibition.

Commencing with the heavier, which is illustrated in Figs. 1, 2 and 3, it will be observed that it is adapted for both adhesion and rack railways. The gage is 29·92 in. The rack mechanism is distinct from the adhesive system, the latter being used on the level and

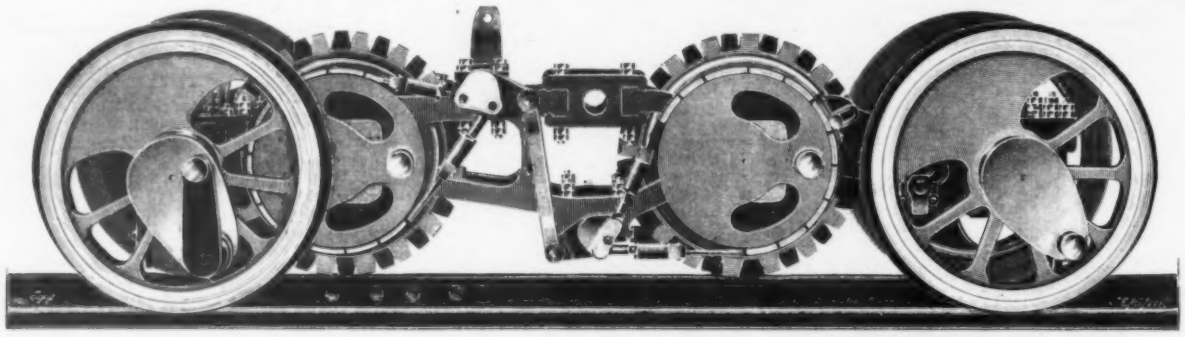


FIG. 2.—TOOTH GEARING OF RACK AND RAIL LOCOMOTIVE—BOSNIA AND HERZEGOVINA RAILWAY.

the lighter gradients, and both systems working together on the rack sections of the line. The leading dimensions are as follows:

| | |
|---|---|
| **Boiler:** | |
| Total heating surface | 958 square feet |
| Heating surface of fire box | 75 " " |
| Heating surface of smoke tubes | 883 " " |
| Length of smoke tubes | 11 ft. 4 in. |
| Outside diameter | 1·65 in. |
| Number | 180 |
| Grate surface about | 17·8 sq. ft. |
| Working pressure | 12 atmospheres |
| **Adhesion factors:** | |
| Diameter of cylinders | 13·38 in. |
| Stroke | 17·72 in. |
| Diameter of driving wheel | 35·5 in. |
| Wheel base of the coupled wheels | 7·67 ft. |
| **Rack factors:** | |
| Diameter of cylinders | 14·17 in. |
| Stroke | 14·17 in. |
| Diameter of toothed wheels | 27·18 in. |
| Wheel base of toothed axles | 3·84 ft. |
| Diameter of free running wheels | 25·59 in. |
| Total wheel base | 22·12 ft. |
| Total working weight | 36·5 tons |

The locomotive consists of the two systems of engines and the boiler carried on the six coupled adhesion wheels, and of the tender carried on four free running wheels. The tender carries the water tanks and coal box, and by means of a transverse spring bears part of the weight of the engines.

The rack system (Figs. 2 and 3) is carried inside the main frame of the machine on wrought iron beams, which terminate in bearings that rest on the axles of the first and last pair of coupled adhesion wheels—an arrangement adopted to prevent the grip of the teeth being affected by the springing movements of the main frame.

These beams are connected to a frame in which are situated the bearings of the cogwheel axles; these axles are two in number, and in the center take a disk form, and each disk carries two cogged tires to correspond with the double rack rail; the teeth are stepped. The cogged tires are not fixed rigidly on the disk, but ten lyre-shaped springs are interposed, being set partly in the disk and partly—the open ends—in the tires; the idea being that if one tire is not gripping properly, the other will bear the whole weight on the axle; the springs will, consequently, be contracted and displace the idle tire until it takes up its share of the load. So, too, by means of adjustable packing at the bearings, the grip of the teeth can be maintained at the right depth, in spite of any wear or derangement. Moreover, the position of the cogwheels and of the connecting rods on the cranks on the axles is such as to insure the simultaneous gripping of as many cogs as possible. The cogwheels are driven by means of connecting rods and cranks, keyed on both ends of the axles; the two connecting rods on each side receiving motion from a common crosshead, which thus acts as a coupling to the two axles. The cylinders belonging thereto are built inside the main frame, and being bolted together, form, at the same time, a rigid connection between the two frame plates and a support for the forward end of the boiler. The valve chests are attached sideways to the cylinder, and project outward over the frame so as to be readily accessible. The valve gear is on the system of Joy, the movement being taken from the connecting rods of the rear cogwheel axle and transmitted by countershafts outward to the valves.

The cylinders of the adhesion system are outside, the valve chest being above the frame: the motion is transmitted in the usual way by connecting rods, the middle wheels of the six coupled adhesion wheels being the driving wheels; the valve gear is also on Joy's system. The same reversing gear serves for both engines. The steam supply arrangements are, however, separate for each pair of cylinders, but the exhaust from all four cylinders is by a common central blow-off pipe.

The locomotive is fitted with five brake appliances: (1) Block brakes on the second and third pair of adhesion wheels, worked from the cab by spindle and hand crank. (2) Band brakes, consisting of steel bands and metal blocks, which lie in a wedge shaped channel in the disk of the cogwheel axles, and are also worked by handle and spindle in the cab. (3) Air brakes for the adhesion cylinder. (4) Air brakes for the cogwheel cylinder. These air brakes work continuously when the rack system is running down a gradient, also when the regulators are shut or when the reversing gear is used during progress. By them the central blow-off pipe is shut off from the cylinders, and simultaneously a connection is made with the open air, so that the steam cylinders act as air pumps and compress air in the valve chests and supply tubes. A valve for each pair of cylinders is connected with the latter, and is worked from the driver's cab; these regulate or stop the escape of this compressed air into the open air, and so the engine can be brought to a standstill at any spot during the descent of the rack sections. (5) A Hardy automatic low pressure brake which operates eight air brake blocks on the tender and the carriage brakes.

There are other special fittings:

For heating the train by steam, a Hausshalter speed indicator, an automatic general lubricator, of which some of the feed tubes may be seen in Fig. 1, for all the cylinders and valve chests and the inside mechanism, two Friedman water feed injectors and water gages.

The tender truck is connected to the engine frame by means of a balance beam, which rests on a ball and socket joint; the coupling to the balance beam is effected by two horizontal coupling bolts, which are keyed in place. A transverse spring under the back cross piece of the engine frame brings the weight of the overhanging part of the engine on to the tender. Therefore, to uncouple the latter, it is simply necessary to loosen the keys and draw back the coupling bolts and raise the transverse spring. This arrangement of the tender, moreover, permits of the taking of curves of 230 ft. radius.

The engine can draw, in addition to its own weight, 85 tons on the maximum inclines of 6 in the 100; 120 tons on gradients of 4·5 in the 100 at a speed of from 5 miles to 6¼ miles per hour; but in the adhesion sections, 19 miles an hour is attained. The rail pressure on each pair of adhesion wheels does not exceed 8 tons.

While the engine just described attracted the attention of engineers and others on account of its large proportions, double sets of engines and nice finish, so the engine shown in Figs. 4, 5 and 6 called for closer inspection, and gave rise to discussions—first, on account of its length, over 30 ft.; and secondly, on account of the complex gearing to provide for the radiating. It was built last year for the 29·92 in. gage railway, for adhesion only; the principal dimensions being:

| | |
|---|---|
| **Boiler:** | |
| Heating surface | 633·14 sq. ft. |
| Grate surface | 9·68 " |
| Steam pressure | 12 atmospheres |
| **Engine:** | |
| Diameter of cylinders | 11·42 in. |
| Stroke | 17·72 in. |
| Diameter of driving wheels | 35·43 in. |
| Wheel base, total | 19·69 ft. |
| Wheel base of coupled wheels | 9·85 ft. |
| Tractive power, about | 2·5 tons |
| Storage capacity for feed water | 79½ cubic ft. |
| Storage capacity for fuel | 60 " |
| Adhesion, about | 19·2 tons |
| Working weight, about | 26·5 " |

The locomotive, Figs. 4, 5 and 6, has six coupled wheels, of which the center pair are fixed in the usual way to the frame, whereas the wheels coupled to this pair are held in specially formed axle boxes, $A_1$ and $A_2$, Figs. 4, 6, which have arms that are held and guided in the direction of the length of the engine by the levers, $B_1$ and $B_2$, and sideways by the guides, C. The levers, $B_1$, $B_2$, are pivoted to the frame at $D_1$, $D_2$, the other ends being attached to the thrust and pull rods, $E_1$, $E_2$, which in their turn are connected to the balance beam, G, which swings vertically on the pivot, F, fixed in the frame. In this way the movements of $B_1$ and $B_2$ are rendered of exactly the same magnitude, but in opposite directions. On the other side of the locomotive the arrangements are precisely similar, and, in order that both sides should work in harmony and enable the axles to assume a radial position, the two sets of gear are connected by the balance beam, I, which is pivoted at the center of the locomotive frame, as shown at I, Fig. 6, and attached to the system by the rod, S. It will thus be seen that the whole ar-

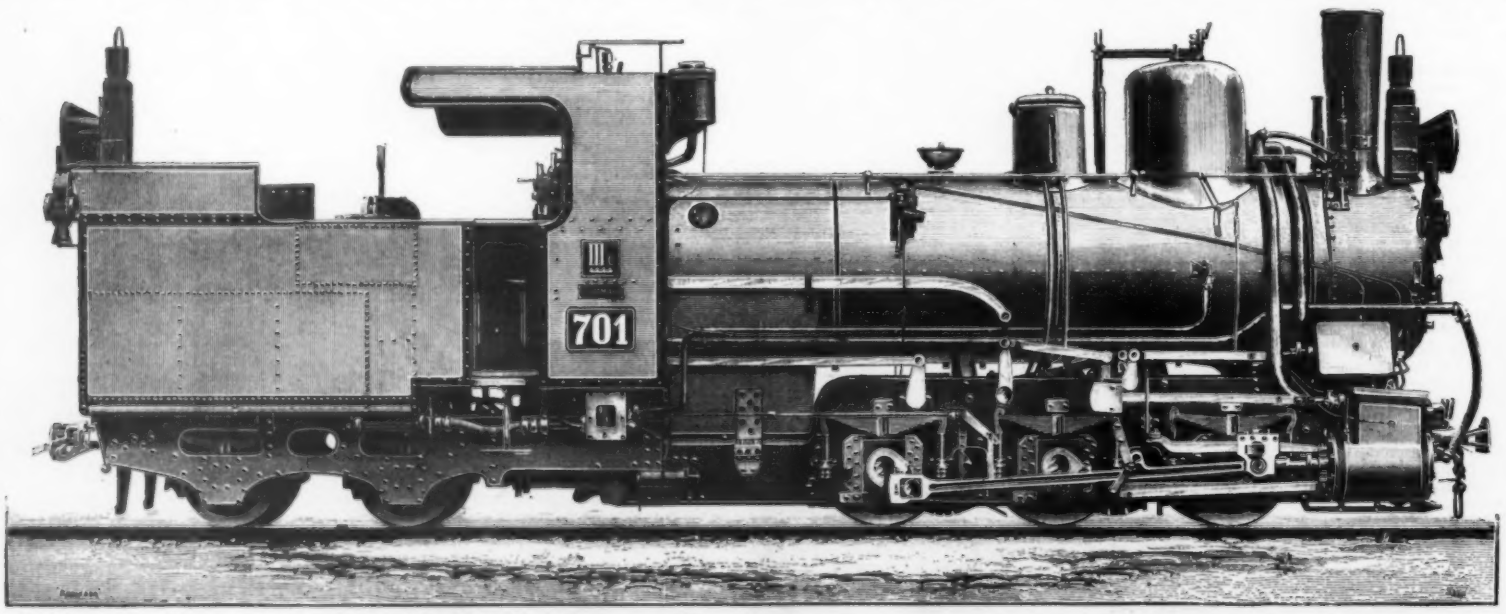



FIG. 1.—RACK AND RAIL LOCOMOTIVE—BOSNIA AND HERZEGOVINA RAILWAY.

Two adhesion cylinders, 13·38 inches diameter by 17·72 inches stroke; two rack cylinders, 14·17 inches diameter by 14·17 inches stroke.

rangement is such that on encountering a curve, the foremost and hindmost of the coupled axles assume a radial position, and to avoid any inconvenience arising from the tender truck not participating in these adjustments, the transverse beam of the tender frame, J, Figs. 4 and 6, is pivoted to a fixed point in the locomotive frame, the ends of this beam being connected to the balance beam, I, by means of two thrust bars, K and $I_4$, with the intervening lever, M, in which there are holes to permit of adjustment for slight variations in the running. In this way, therefore, the movements of the tender truck on curves are also brought under the control of the balance beam, I, and so it works in accord with the radial axles.

In order to bring the coupling rods under the influ-

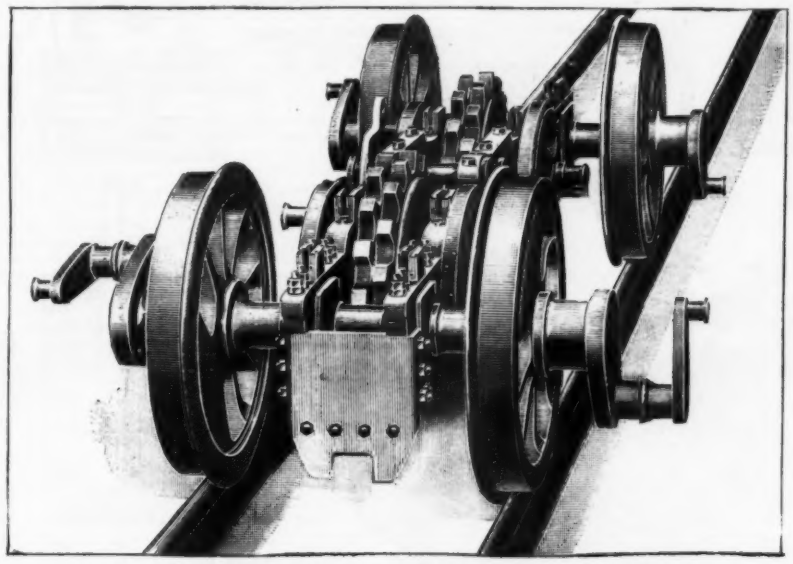


FIG. 3.—TOOTH GEARING OF RACK AND RAIL LOCOMOTIVE.

ence of the systems, they are attached to a differential head, O, carried on the driving crank; this head constitutes an equal armed lever, and as the two ends hold the coupling rods, $P_1$, $P_2$, Fig. 4, it is obvious that the latter can follow the radial movements of the axles. The inclined position of the coupling rods is fully compensated by their being parallel to the arms of the axle boxes, $A_1$ and $A_2$, Figs. 4 and 6.

The arrangements described suffice for fixing the position of the coupled wheels and their rods, but in order to avoid the foremost and hindmost of these axles running counter to one another on small curves, where the displacement is great, the differential head, O, Fig. 4, is put into connection with the lever system of the axle boxes by means of the parallelogram, Q, Q, attached to O at two points; while Q, Q, through the intervention of the plate, R, is placed in connection with the parallelogram, T, T, and at the other end the latter is attached—free to move—to the lever, H, which is carried by the balance beam, G, already mentioned. This arrangement, it will be seen, places the position of the differential head under the control of the radial position of the axle boxes.

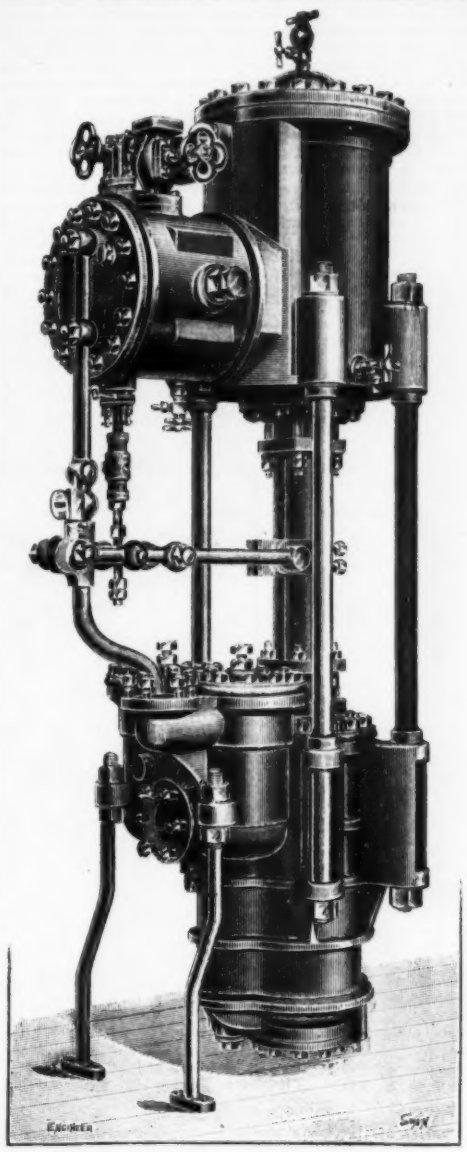
So much, then, for the radiating scheme of this loco-

motive, which, judging from the fact that it has been in use some time and is still adopted, must be assumed to give satisfaction. In fact, a suggestion that the complicated gearing of these locomotives would occasion frequent derangement and repairs has led the engineer, R. Von Mertins, chief director of traffic on the Bosnian Railway, to comment on the remarkably easy running of these locomotives, and to publish some statistics of their running during the five years 1890–94, from which it may be gathered that during 1894 nineteen of these locomotives were in use; that they ran a total milage of 436,335 miles, averaging for each locomotive 22,965 miles; while during the whole period of five years the annual average mileage per locomotive is 23,262½ miles. The cost of repairs during 1894 of the nineteen locomotives was $5,726.23, making the average cost of repairs per locomotive mile 1·41 cents, the same factor for the whole period of five years being 1·25 cents.

We are indebted to the courtesy of the Engineer for illustrations and particulars.

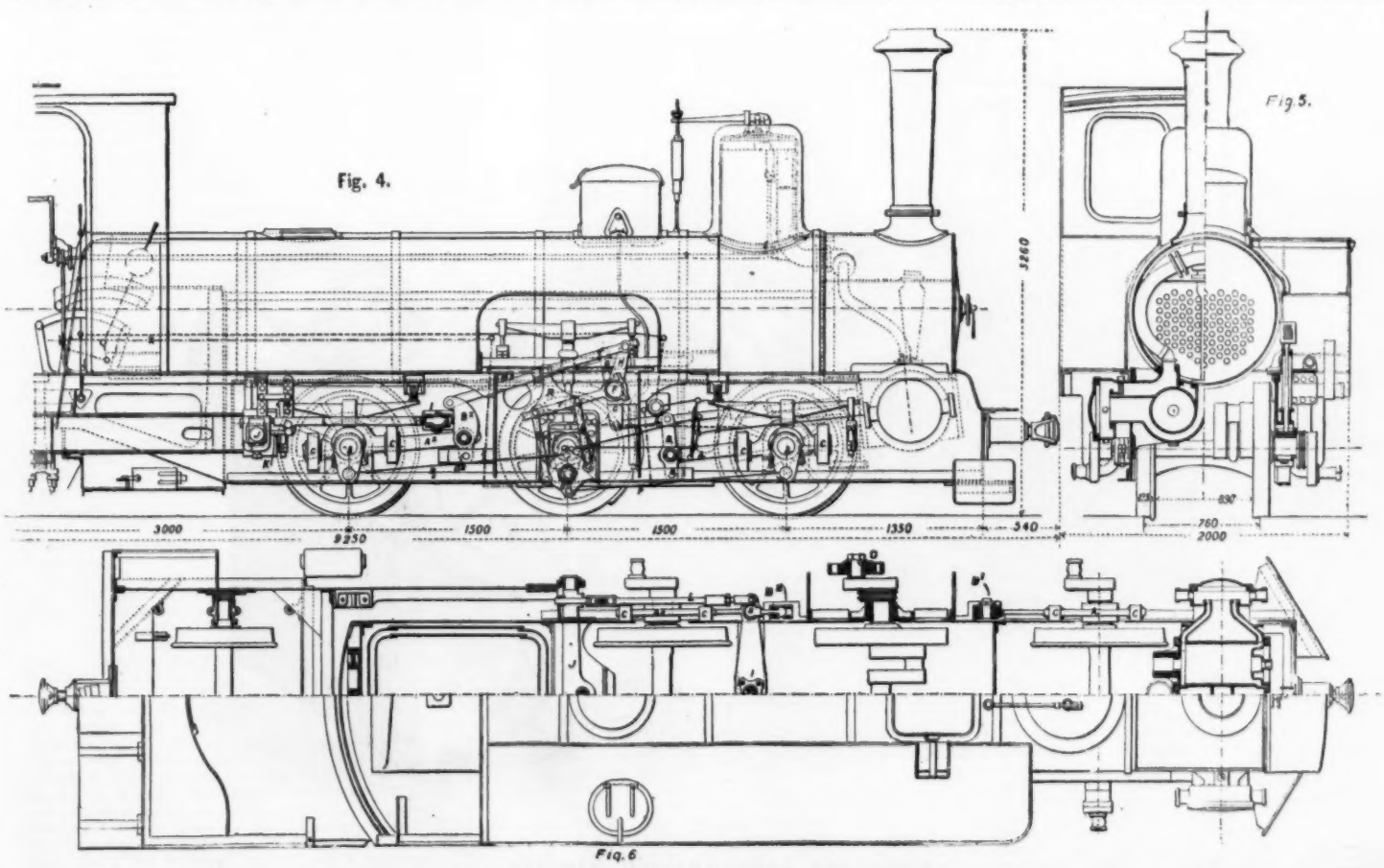
## FEED PUMPS FOR WATER TUBE BOILERS.

THE Engineer quotes Mr. Robinson, of the United States Navy, as saying, in a report on Belleville boilers, "it is the pump which makes the boiler." The Belleville is a style of water tube boiler which has been in use for several years, and in which no more water is contained than is required for conversion into steam. These boilers were adopted for the large new British battleships Powerful and Terrible, of about 18,000 horse power each, and a good deal of thought was given to the special pumps to be used with them, whose design and construction were intrusted to G. & J. Weir, of Cathcart. The pump is shown in the accompanying illustration, for which we are indebted to the Engineer. The Powerful is fitted with fourteen of these direct acting feed pumps, six as main feeds and eight as auxiliaries. The main feed pumps are 10⅛ in. in diameter and



FEED PUMPS OF THE BRITISH BATTLESHIP POWERFUL.

16 in. stroke, three of them being placed in each engine room. Four of the auxiliaries are duplicates of these pumps and four are 8¾ in. in diameter by 15 in. stroke, one being placed in each boiler room. The main feed




KLOSE RADIAL LOCOMOTIVE—BOSNIA AND HERZEGOVINA RAILWAY.

pumps draw by separate lines of feed pipes from the feed tanks, and each delivers independently to a compartment of eight boilers, where the water is conveyed by branch pipes to the boilers through the feed regulators. The auxiliary pumps also draw from the main feed tanks by independent pipes, and have besides suctions from the reserve tanks. They are double acting, with water ends of gun metal and rods of manganese bronze, and the entire gearing has been designed with a view to rigidity and strength. The water valves are of the Weir patent "Group" type, with gun metal seats, and the steam valves are of a special design for high pressure steam, in this case 260 pounds per square inch. The pump buckets have also a new design of special packing rings, and all the pumps have on the various trials worked with the highest efficiency and without the slighest hitch. As the feed water enters the steam chambers in the Belleville feed system at a much higher pressure than that of the boiler steam, Messrs. Weir have designed an ingenious controlling gear to prevent an excessive pressure of the pump discharge, which automatically checks the work of the feed pumps when this pressure exceeds a certain amount. It may be stated that the Powerful has forty-eight boilers divided into eight groups.

## KILBOURN'S REFRIGERATING MACHINE.

THE refrigerating machine which we illustrate has been specially designed by the makers, the Kilbourn Patent Refrigerator Company, Limited, Dublin Street, Liverpool, for the refrigeration of ships, and is rated at 12 tons refrigeration, or the equivalent in cooling power to the melting of 12 tons of ice from and at 32° F. in 24 hours. For the carriage of chilled beef it will maintain well insulated chambers of 30,000 cubic feet capacity at the required temperature, or, if used for the carriage of frozen mutton, 50,000 cubic feet.

The motive power is a well finished compound engine, with such an arrangement of steam and exhaust valves

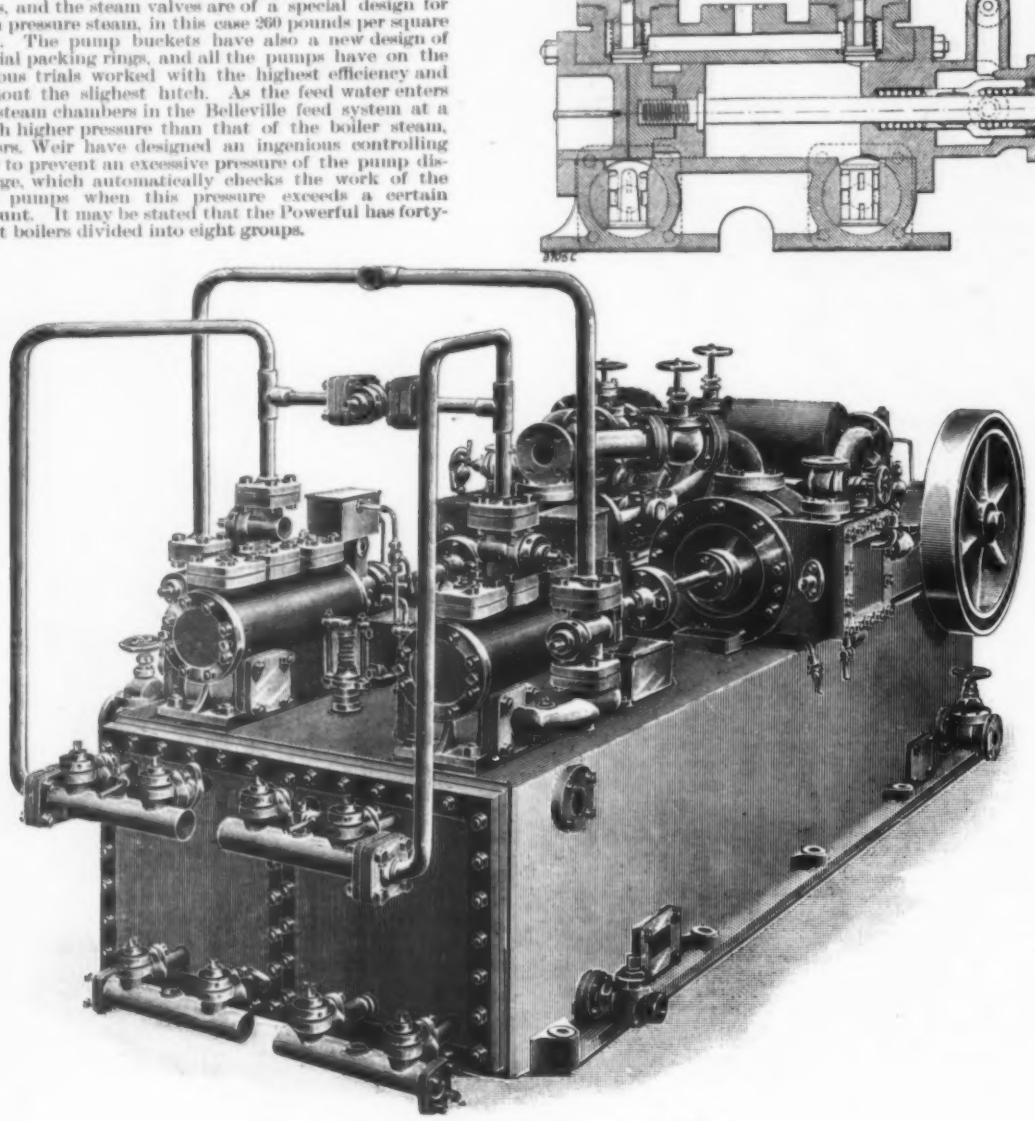
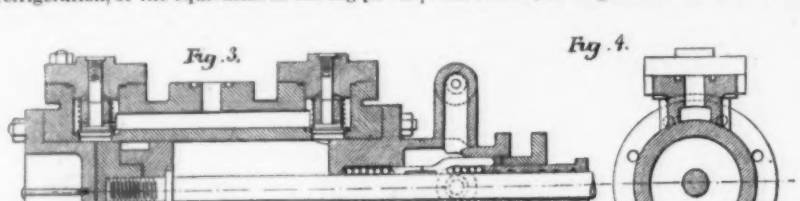
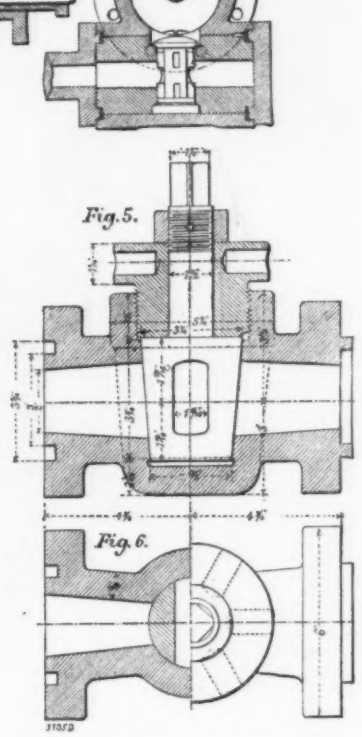


FIG. 1.




DETAILS OF KILBOURN'S REFRIGERATING MACHINE.

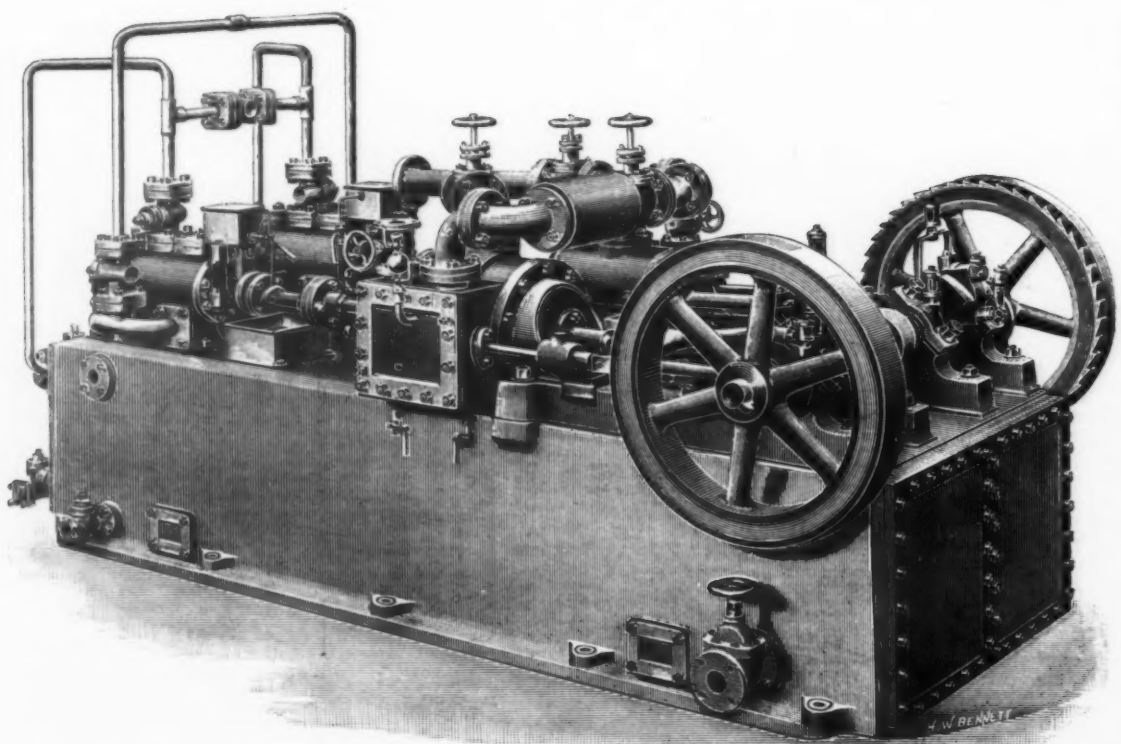


FIG. 2.

KILBOURN'S REFRIGERATING MACHINE.

that, if necessary, the crankshaft may be uncoupled, and either engine worked high pressure independently of the other.

The ammonia compressors are made of special close-grained cast iron, and are fitted with Webb's patent suction valves, the seat of which consists of a cylindrical plug capable of being withdrawn with the valve without disturbing any of the pipe connections. The delivery valves are of steel, with a central guide spindle; both suction and delivery valves are arranged with the special view of reducing the clearance to a minimum, while retaining the vertical line of lift so essential to the perfect seating and life of the valves.

The pistons are of cast iron, fitted with special metallic packing; the junk ring is of wrought iron, and also forms the nut for securing the piston on the rod.

The double stuffing boxes are an important detail of the Kilbourn machines: they are so arranged that they provide an annular space which is kept filled with a special oil, in which the rod runs; a gage glass is fitted on the side to indicate the height of the oil in the chamber. The glands are so arranged that the packing in the inner or outer stuffing box may be tightened at will. The lubrication of the compressor is maintained by a small plunger pump worked by a cord and wheel from the crankshaft; this pump draws its supply from the reservoir tank immediately below the compressor glands, and, by a suitable arrangement of cocks and pipes, can discharge the oil into the annular space between the stuffing boxes, or into the small tank above the glands, whence it runs in a continuous stream into the recessed gland of the outer stuffing box, and so back to the reservoir. Provision is also made to inject oil into the suction pipes when necessary. The design of the ammonia cock (Fig. 5) is another important feature of the compressor. It comprises a shell into which is fitted a screwed gland; on the neck of the plug is screwed a collar with a taper pin through it. To work the cock, a bar is put in one of the radial holes in the gland, and a slight pull to the right causes the top of the gland to bear against the underside of the collar on the plug, thus raising the plug very slightly out of its seat; the plug can then be rotated as required, and when in position is again firmly pressed home to its seat by a slight movement of the gland to the left. The Kilbourn Company have fitted all their machines with this patent cock on account of the great difficulty of making valves perfectly tight under ammonia pressure.

The ammonia condenser consists of four long oval coils of 1½ in. (external diameter) lap welded hydraulic tubing, contained in the deep box bedplate on which the engine and compressors are fitted. There is a central division, making two independent condensers, while the cocks are so arranged as to make the condensers interchangeable with either compressor. A special feature of these condensers is that any coil may be shut off top and bottom by the cocks shown on the tee pieces. There are no internal joints, the ends of the coils passing through the covers in small packed glands. The coils may be withdrawn at either end.

The Kilbourn Patent Refrigerator Company have lately supplied many of these machines for the carriage of chilled beef from America, and all of them have given satisfaction.

## THE SCOTTE STEAM OMNIBUS.

AUTOMOBILE locomotion has made so great progress during the last few years that we may anticipate the substitution, in the near future, of mechanical propulsion for traction by horses for both industrial purposes and passenger service.

Steam, compressed air, electric and other forms of propulsion have already been substituted for traction by horses upon the majority of tramway lines, after an attempt to use chemical agents, which, up to the present, have not given so satisfactory results.

Since the competition instituted by the Petit Journal in 1894, the progress made by light vehicles run by gasoline motors has been very great. The development of gasoline carriages has even been so rapid and so great that such mode of locomotion will not remain solely a matter of luxury, but will soon be applied to ordinary hired coaches. The administrative regulations are already prepared, and various companies are shortly to put such vehicles on the road.

The application of mechanical propulsion to heavy vehicles upon roads, without the use of rails, no longer presents any difficulty. From the numerous experiments tried up to the present, it seems that it is steam that holds the first rank as a motive power, and that has the advantage over gasoline.

In fact, among the different systems of omnibuses constructed up to the present, we observe especially, as having given quite practical results, those of Scotte, Le Blant, Bollée, De Dion, Bouton, and others, all of which employ steam generators and motors. It is with great trouble that carriages capable of seating ten persons are run by gasoline motors.

It is not without having to struggle with numerous difficulties that these inventors have succeeded in obtaining practical solutions of mechanical locomotion upon roads. Their celebrated predecessors, more than a century ago, were Cugnot, in France, with his steam truck, in 1769; Oliver Evans, in America, in 1786; and Trevithick and Vivian in England, in 1801. The last named, in reality, applied and developed the ideas of Evans, who recommended the use of the high pressure steam engine.

As with all inventions, it required numerous tentatives and prolonged experiments before the present degree of perfection was reached. It would take too long to enumerate all of them in this place. We shall be content to make known those experiments whose results have been crowned with success since the Petit Journal competition.

The recent experiments made in the department of the Meuse with the Scotte train lead us to speak of this system first. Its inventor, Mr. Scotte, is an extensive manufacturer of hats at Epernay, just as Oliver Evans was a cartwright and Fulton a landscape painter at the beginning of his career and before attaining celebrity. Mr. Scotte, who has an inventive and practical mind, about ten years ago constructed a carriage for four persons for his own personal use. This carriage had been run for a long time at Epernay when the Petit Journal contest was organized. The idea at once occurred to Mr. Scotte to take part in it, and, in fact, he participated therein without any special preparation. Unfortunately for him, a slight accident that happened to his boiler (the breakage of a metallic plug, no duplicates of which had been carried along) made it impossible for him to continue the race. Nevertheless, the Petit Journal awarded a prize of encouragement to the unlucky competitor.

Having made different experiments with his carriage employed as a hauler, Mr. Scotte modified his first model and constructed a larger one, serving as a hauler and to which was attached a passenger carriage.

The first train of this kind, belonging to Mr. Sadot, did regular service for a short time between Pont-l'Abbé-Picauville and Chef-de-Pont station, in the department of La Manche. As the traffic did not seem to be sufficiently remunerative in this locality, the omnibus, or rather steam train, was taken to Cherbourg, where it did service between Tourlaville and Equeurdreville.

Finally, once more improving his system of steam carriage, Mr. Scotte has just undertaken a series of practical experiments in the department of the Meuse, after making a series of preliminary ones in the suburbs of Paris (Fig. 2). We had an opportunity of taking part in one of these experiments last July between Paris and Saint Cloud, and covered the distance that separates Mirabeau bridge from the crossroads of Montretout in less than an hour, in passing over the declivity of Saint Cloud, which has a gradient of no less than one inch to the foot.

The Scotte passenger train consists of a steam carriage with a seating capacity for fourteen persons, exclusive of the two train hands, and a trailing carriage capable of carrying twenty-four persons. The whole affair is very harmonious and of a light aspect and even of an elegant outline for carriages of this kind.

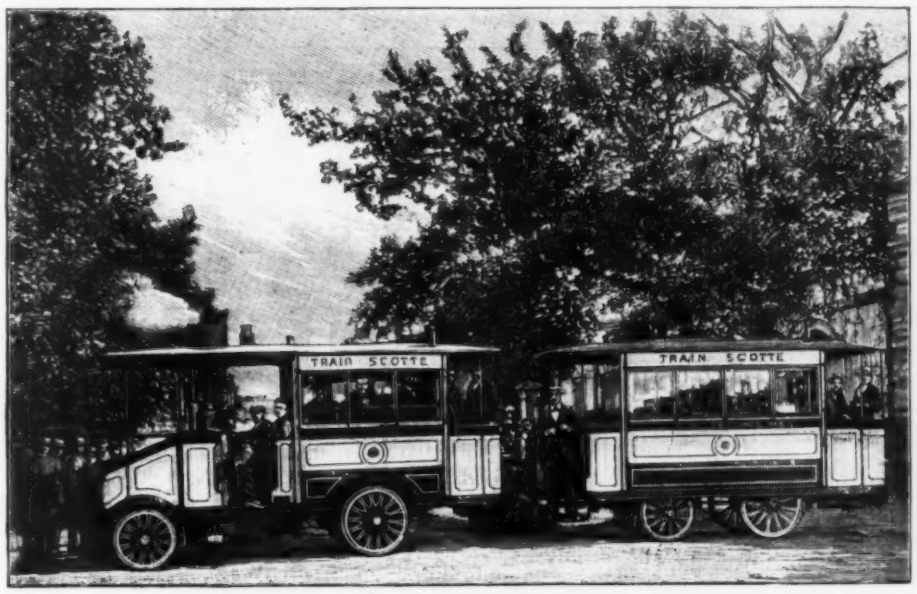



FIG. 1.—SCOTTE'S STEAM OMNIBUS.

Just in front of the motor and generator is the fuel box, which is capable of holding 440 pounds of coke or coal—a quantity sufficient for a run of four hours.

The supply of water of 125 gallons is contained in tanks placed under the seats and under the floor of the passenger coach.

The steam carriage is provided with a quick acting brake actuated by a pedal, and with a screw brake actuated by a hand wheel.

This same carriage carries five kerosene lighting apparatus, while the trailer carries two. The dimensions of the steam carriage are: Length, 17 feet, and width, 6 feet. The total weight, empty, is 7,700 pounds.

The trailer is 15 by 6 feet. Its weight, empty, is 3,300 pounds. The Scotte train is capable of turning in a circle of 11·5 feet radius.

The Scotte establishment is likewise constructing a freight train composed of a steam carriage and a trailer capable of carrying, both together, from five to six tons at a mean speed of from 3·5 to 4 miles an hour.

The experiments made up to the present permit of the hope that steam omnibus lines will soon be instituted capable of furnishing cities and their suburbs with rapid and safe means of locomotion. Through their great elasticity of motion, the ease with which they are run and steered, these steam omnibuses will soon become the indispensable means of rapid transit in large cities.—La Nature.

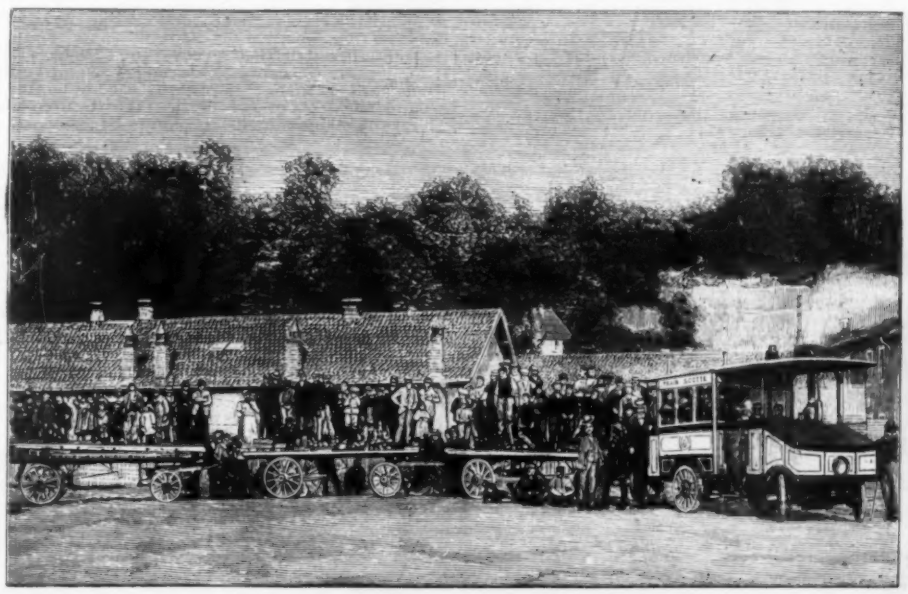


FIG. 2.—SCOTTE'S FIRST STEAM TRAIN RUNNING BETWEEN PONT L'ABBE AND CHEF-DE-PONT.

The motor and generator are situated in front and are completely separated from the passengers by a glazed partition (Fig. 1).

The motor is vertical, and has two cylinders with variable expansion and with change of speed and reversal of direction. It is of 16 horse power. The generator, which likewise is vertical, is of the improved Field type. The motion is communicated to the hind wheels, which alone are driving ones. They are of very small diameter and are actuated by jointed steel chains. The front wheels, which are the steering ones, revolve around a vertical journal actuated by the engineman.

## ALUMINUM FOR PASSENGER CARS.

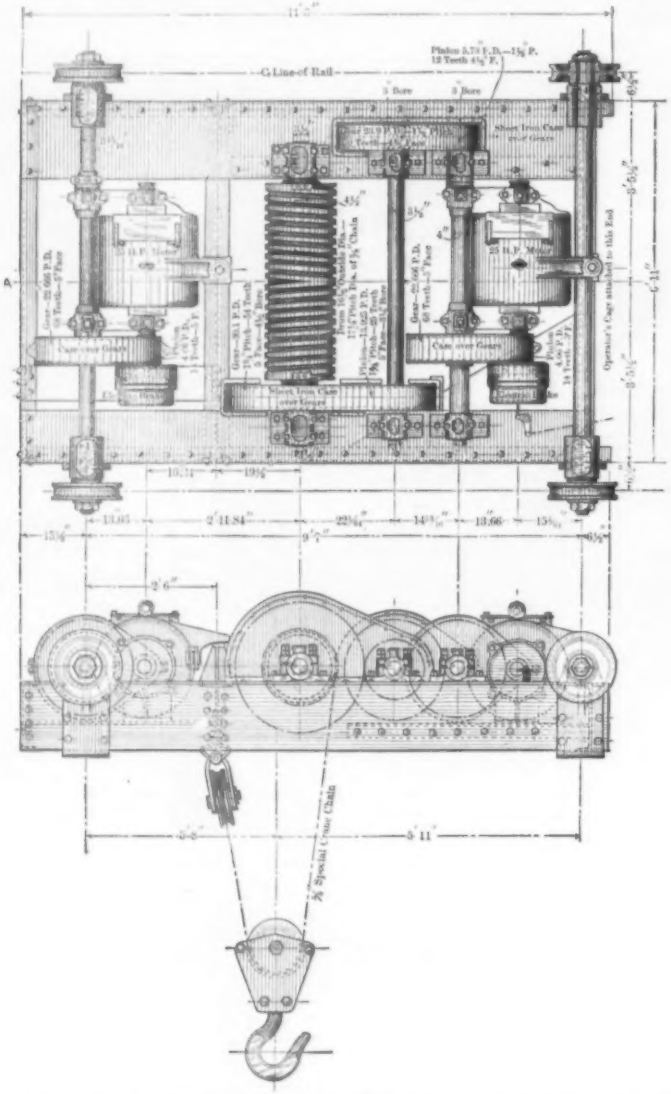
ACCORDING to the journal Schmalspurbahn ("Narrow Gage Road"), the management of the French state railways has obtained permission from the minister of railways for the construction and reconstruction of a number of passenger cars in which all the parts formerly manufactured from brass, copper and iron, with the exception of axles, wheels, bearings and springs, brake beams and couplings, shall be constructed of aluminum. The weight of a car provided with aluminum trimmings was one and one half tons less than that of an old style car. It should be added that the French passenger coaches are much smaller than the American cars. As an ordinary train in France consists of twenty coaches, the weight of the train would be reduced by thirty tons, which means a considerable saving in operating expenses.

## A TWO HUNDRED FOOT GANTRY CRANE.*

By John W. Seaver, Cleveland, O., member of the American Society of Mechanical Engineers.

In the latter part of the year 1895, the Cambria Iron Company, of Johnstown, Pa., decided to construct a storage and loading yard for their proposed new structural mill at Johnstown, Pa., and invited several engineering firms to submit estimates and designs for a plant to handle the material that it was intended to store and load in this yard. Among the firms invited to submit proposals, that with which the writer is connected took up the matter at once, and gave it a great deal of very careful study. The yard it was designed to cover—400 by 800 feet—was so large that it was evident from the beginning that unless some very economical form of construction should be proposed, the expense of covering the area would be very great. There are several methods by which the desired object can be attained, and each plan was carefully considered and its objections and advantages compared.

A very simple way of covering any area is by the use of stationary derricks with swinging jibs. This, while probably the cheapest construction, is at the same time the most objectionable, on account of its requiring a large number of derricks to cover the surface. In fact, swinging derricks cannot be arranged so as to cover the whole yard, as there is necessarily a considerable area around the foot of the derrick that is unavailable. These objections caused this plan to be dismissed.

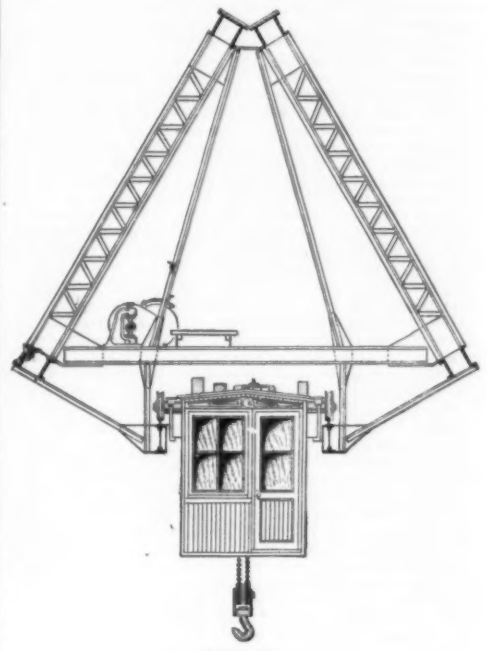



TRAVELING TROLLEY OF TWO HUNDRED FOOT GANTRY CRANE, SHOWING THE TWO 25 HORSE POWER ELECTRIC MOTORS.

* Paper presented at the New York meeting (December, 1896) of the American Society of Mechanical Engineers.

The next plan that was considered was a system of surface tracks, between which the material to be stored would be piled, and on these tracks a number of locomotive cranes could be placed. Two of the objections against the plan of a stationary derrick system could very properly be raised against this second plan with even greater force, as the tracks upon which the locomotive cranes would travel would occupy a very large portion of the yard. The locomotive cranes would be very expensive, and their range of length of jib is quite limited.

A third form of construction, and one that seemed to offer several advantages over the first two plans, consisted in a series of overhead tracks, running parallel to the length of the yard, and, mounted on these tracks, were to be a number of overhead traveling cranes of the ordinary type. Against this plan could be urged the fact that the supports themselves would take up more or less room, and the foundations, columns and stringers for these supports would be very expensive,



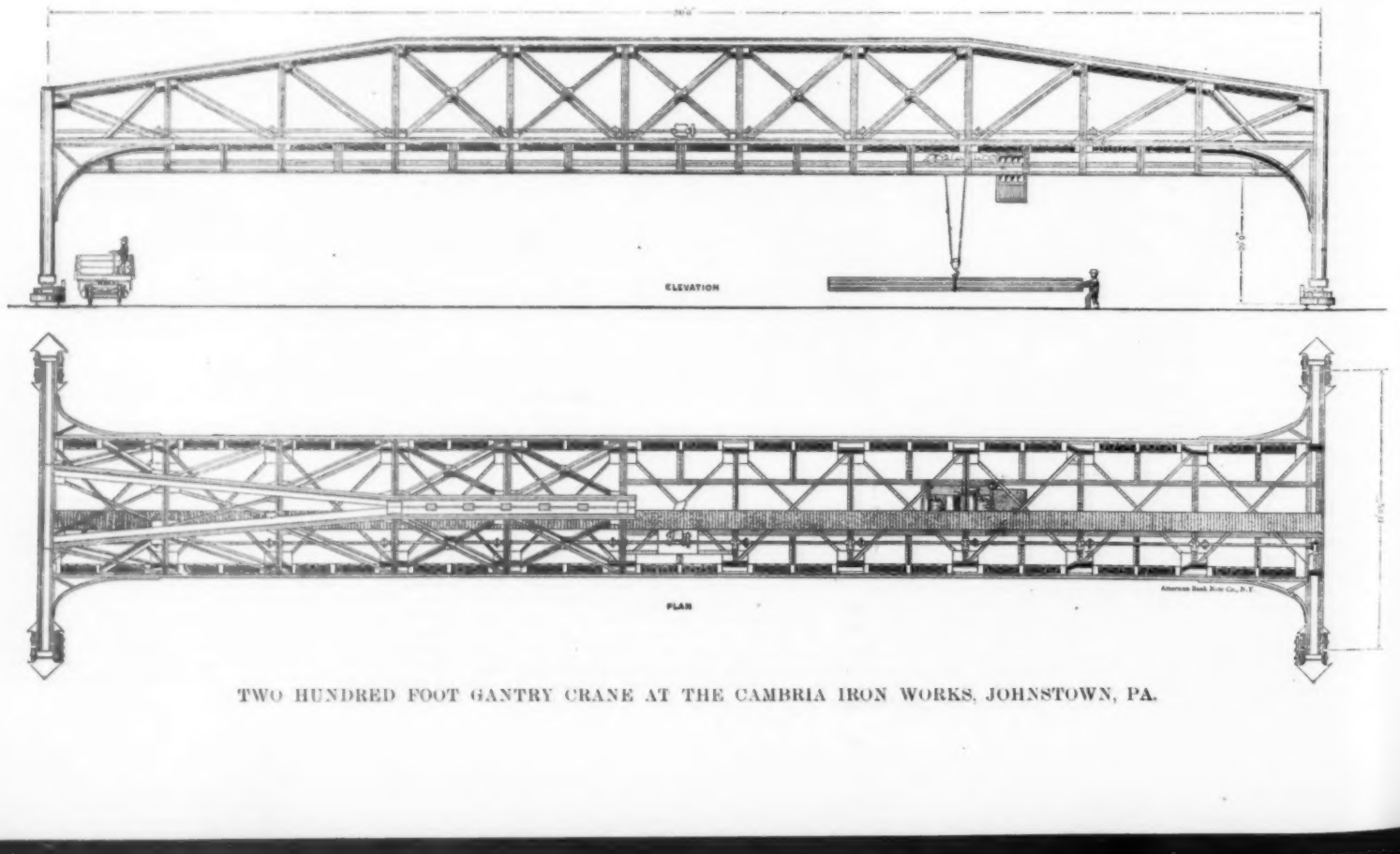

TRANSVERSE SECTION THROUGH INCLINED TRUSSES, SHOWING TRAVELING TROLLEY AND OPERATOR'S CAGE.

as it was proposed to make the cranes of exceptionally long span (100 feet centers of supports). This span would make the overhead ties or bracing very expensive.

Dispensing with the overhead bracing would necessitate the columns supporting the overhead tracks to be sufficiently rigid in themselves to maintain the tracks in perfect alignment, and, in addition to this, they would require exceptionally heavy and good foundations and anchorages.

The cranes themselves would be expensive, and, should the surface of the whole yard be covered, which would necessitate four cranes each 100 foot span, it would mean the employment of four operators—one for each crane.

These were the principal objections to the overhead crane system, but they were deemed sufficient to cause




TWO HUNDRED FOOT GANTRY CRANE AT THE CAMBRIA IRON WORKS, JOHNSTOWN, PA.

the rejection of this plan in favor of the gantry crane system.

This plan contemplates the use of two traveling cranes, each 200 feet span, running upon tracks on the surface of the ground, parallel to the length of the yard, so that the two cranes cover the whole surface, with the exception of three spaces, one five feet wide down each outside edge of the yard, and one ten feet wide down the center. There is one line of track down each outside edge, and two lines of track down the center.

It was proposed to mount the cranes upon end frames or legs, making them what are commonly called "gantry cranes," and to make the legs or end supports of sufficient height to allow a train of cars with men on top of same to pass freely underneath. For this purpose the clear height from the top of the rail to the underside of the stringer that the crane trolley traverses was fixed at 20 feet 0 inches; and as the height from the surface of the yard to the top of the rail is 14½ inches, a clear height from the surface of the ground to the underside of the crane of 21 feet 2½ inches is obtained.

The magnitude of these proposed gantries caused the matter to be most carefully considered, both by the Cambria Iron Company and the Wellman Seaver Engineering Company, who submitted this plan to them for their consideration.

After a thorough examination of the plan proposed by them they were awarded the contract.

The firm, before submitting their proposal for this crane, very carefully considered all the various forms of cranes, both of the regular traveling and the gantry types, that are at present in use, and, after a thorough investigation of the different types, decided upon a form of construction that they believe to be entirely original. It consists of two main girders of the Pratt type, with vertical posts and diagonal tension braces, the bottom chord being straight, and the top chord parallel to the bottom chord for about one-half its length, and then inclining to the end posts at such an angle that the depth of truss at the ends is one-half that at the center. These two main trusses are framed together at an angle of 60°. The top chords have their parallel portions connected with splice and tie plates. The bottom chords are parallel to each other, and separated a distance of 20 feet. The main trusses are 18 feet deep at the center and 9 feet deep at the ends.

This peculiar form of construction gives the arrangement of the main trusses the appearance of a steep hipped roof, very long in proportion to its height. A cross section at the center is that of an equilateral triangle, and the cross section of any point between the end posts and where the top chords join each other is that of a trapezoid.

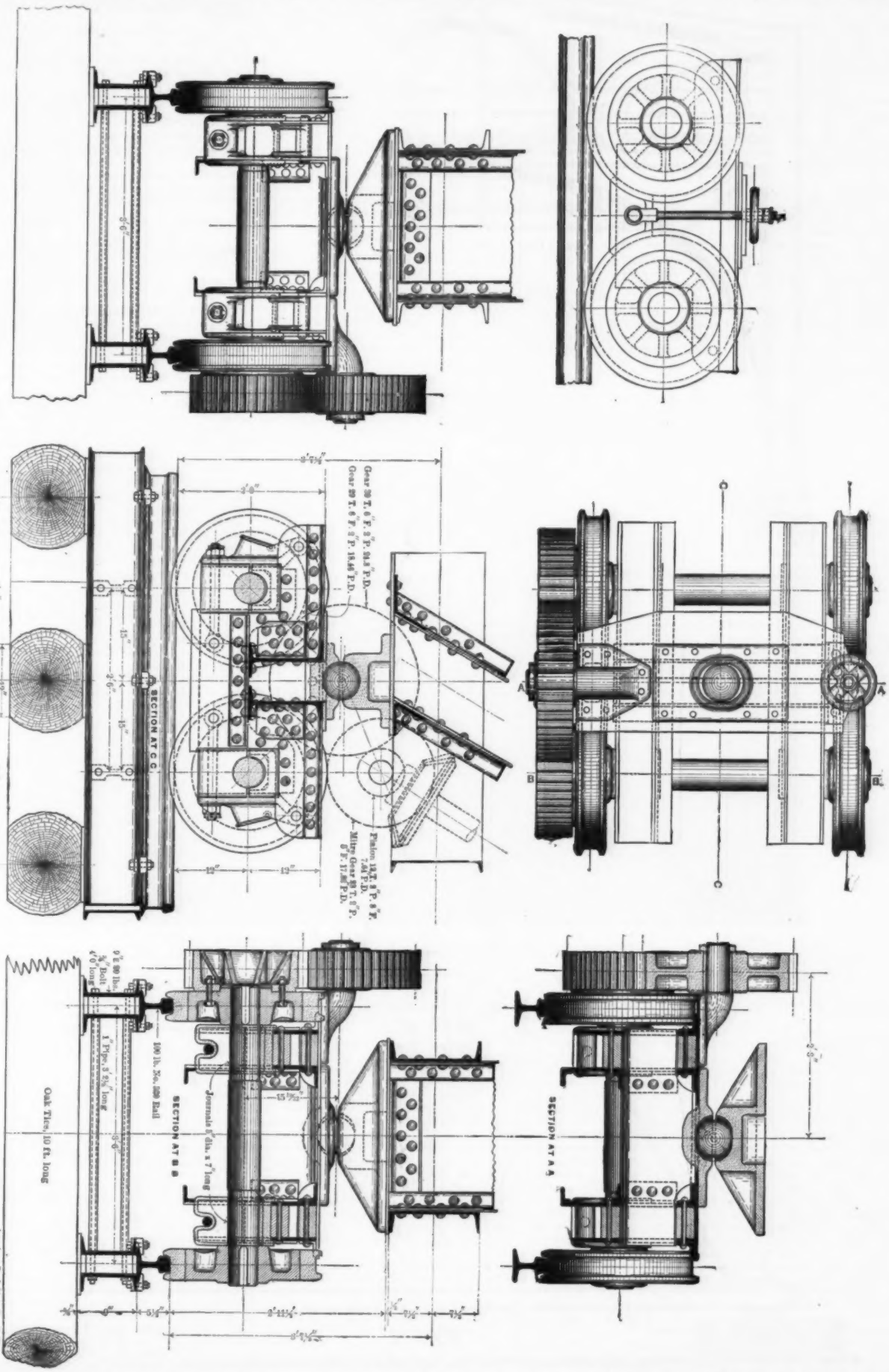
Suspended beneath the bracing that separates the bottom chords is a runway for the crane trolley to travel on. This runway consists of riveted I beams, with T rails secured to their upper flanges.

The stringers are very rigidly braced to the chords of the main trusses, not only at the panel points, where they were suspended, but also at the middle of each panel.

The horizontal bracing between the trusses consists of a series of floor beams, firmly riveted to the posts of the trusses, and forming the struts of the lateral system.

The diagonal members consist of angle irons riveted

DETAILS OF THE TRUCKS FOR TWO HUNDRED FOOT GANTRY CRANE.



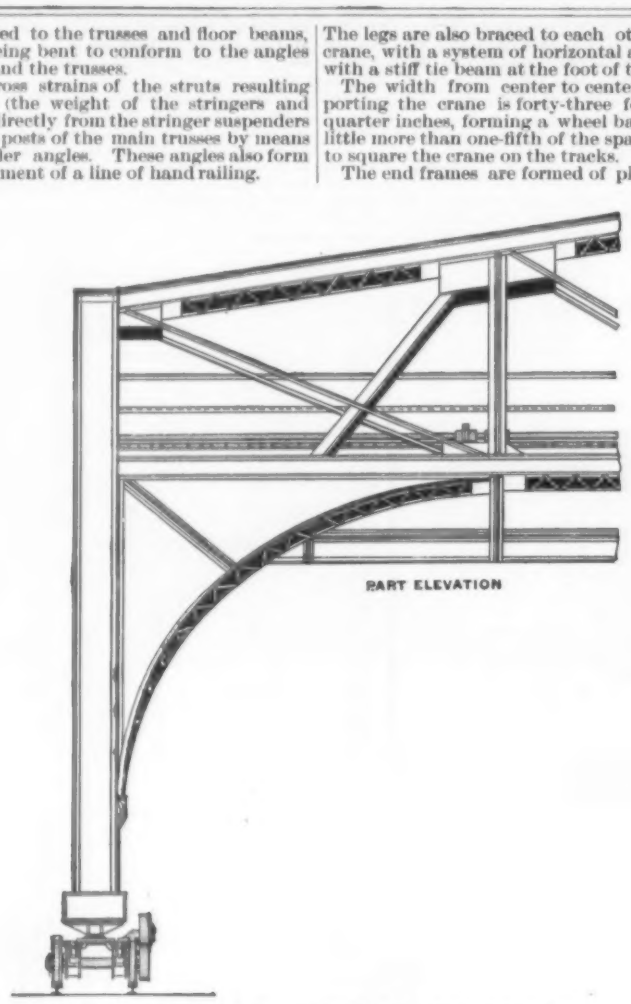
to wing plates secured to the trusses and floor beams, these wing plates being bent to conform to the angles of the floor system and the trusses.

To prevent any cross strains of the struts resulting from the live load (the weight of the stringers and trolley), it is taken directly from the stringer suspenders up to the top of the posts of the main trusses by means of diagonal suspender angles. These angles also form posts for the attachment of a line of hand railing.

The legs are also braced to each other crosswise of the crane, with a system of horizontal and diagonal braces, with a stiff tie beam at the foot of the legs.

The width from center to center of the trucks supporting the crane is forty-three feet nine and three-quarter inches, forming a wheel base for the crane of a little more than one-fifth of the span, which is sufficient to square the crane on the tracks.

The end frames are formed of plates and angles, arranged so as to present a smooth end surface, the corners of the openings being filled in with curves of large radii.




SIDE VIEW OF END FRAMES OR LEGS OF TWO HUNDRED FOOT GANTRY CRANE.

Resting on top of the floor beams are two lines of channel irons parallel to the main trusses. These channel irons form stringers for the foot walk, which extends the full length of the crane. The walk is made of two thicknesses of pine plank with tar paper between. The floor beams also carry the pillow blocks for the main shafting. At the ends of the crane, and in the plane of the trusses, are carried down riveted legs, or supports of the box form. These legs are firmly braced to the bottom chords of the main trusses, with large plate iron brackets, well stiffened with angle iron flanges.

The top chords are made of two channel irons with a cover plate on top, and latticing on the bottom. The bottom chords are made of two channel irons, latticed on top and bottom so as to afford no room for lodgment of moisture; this point being carefully kept in view throughout the construction.

The vertical posts of the trusses each consist of four angle irons latticed together. The diagonal members of the trusses are each formed of two angle irons riveted at their intersection. Particular care was paid to the connections of all members.

The loads and strains adopted for this crane were as follows: A live load for trolley equal to 20,000 pounds. To this was added, for impact, 25 per cent., or 5,000 pounds. The weight of the trolley was estimated at 23,000 pounds—making a total of 48,000 pounds distributed on four wheels, spaced about nine feet centers, bringing a reaction upon each stringer support of 18,000 pounds.

To still further provide for any sudden application of a live load, it was assumed to be equal to 22,000 pounds applied at any panel point of bottom chord of each truss.

This is largely in excess of any load that will come upon the crane; but it was considered advisable to use it, in view of the fact that the load might catch, thereby bringing a greatly increased weight upon the trolley.

The dead load, weight of trusses and floor, was assumed at 88,000 pounds per truss, or 8,000 at every point of bottom chord of each truss.

In order to provide for a very large factor of safety in the bottom lateral system, a wind pressure of twenty pounds per square foot was assumed, or a load of 5,000 pounds at each panel point of bottom chord. To resist these combined loads, the following limitations of strains were adopted:

| | | | |
|---|---|---|---|
| For live loads. | Tension | 12,000 | lb. per sq. in. of net section. |
| | Shear | 6,000 | " " " " " " |
| | Compression | 10,000 | " of gross section. |
| Bearing on rivets and bolts | | 12,000 | " per sq. in. |
| For dead load. | Tension | 15,000 | " " " " of net section |
| | Shearing | 10,000 | " " " " " " |
| | Compression | 12,000 | " " " " " gross section |
| Bearings on rivets and bolts | | 15,000 | " " " " |

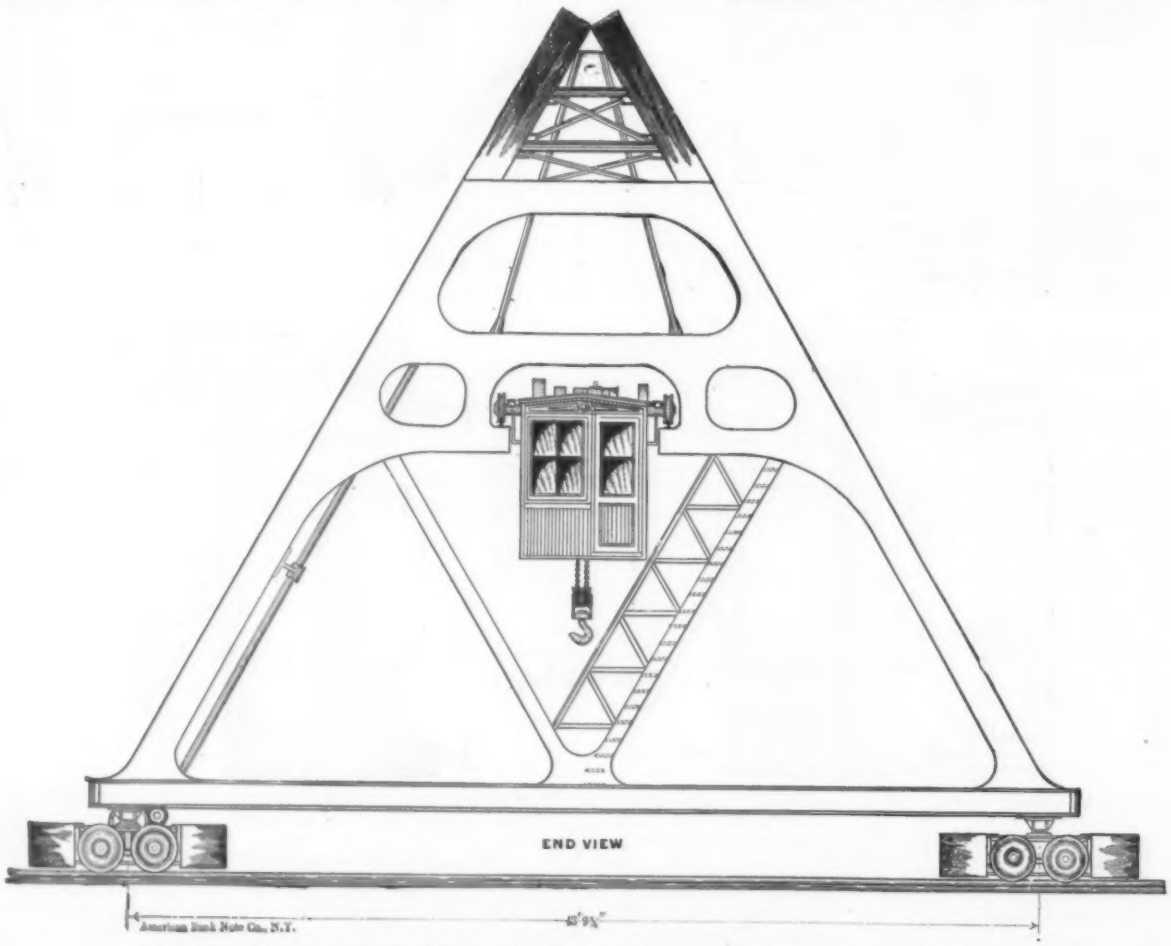
In all the compression members a proper reduction of the strains was made in all long members, so as to insure the same general factor of safety throughout, and the strains in the bottom lateral system were still further reduced to 10,000 pounds per square inch in tension and 8,000 pounds per square inch in compression. All of these strains are largely in excess of what the writer would recommend for an ordinary crane construction; but the ratio of dead load to live load is so great that it was necessary to observe the greatest possible economy of material to avoid the crane being so heavy that it would be impracticable.

The truss members were not all proportioned to comply exactly with the areas that the above limitations of strains called for. They were never made of less sections, and in several cases the section was increased in order to obtain the necessary stiffness. This will account for the seemingly largely increased area of some of the members over that required by theory.

The minimum speeds of the various motions of the crane are as follows:

| | | |
|---|---|---|
| Traverse of main bridge | 200 | feet per minute. |
| " trolley | 400 | " |
| Hoist with full load | 20 | " |

The crane rests upon four trucks; each having four steel tired double flange wheels, twenty-four inches in diameter. The wheels are keyed to steel axles, five inches in diameter. The gage of the track is three feet six inches centers of rails. The journals are five inches in diameter, seven inches long, fitted with bronze bearings carried in cast steel oil boxes, with ample provision for lubrication. The wheels on one truck at each end are connected by means of a system of shafts and beveled gear wheels. The gear wheels are steel cast-




END VIEW OF END FRAME OR LEGS OF TWO HUNDRED FOOT GANTRY CRANE.

ings, and are of extra heavy design throughout. The shafting from one truck to the other is four inches in diameter. The couplings are all rigid flanged couplings, tightly keyed to the shafts, and fitted with turned bolts of a tight driving fit. The main shaft, extending the length of the crane, is carried in universal bearing pillow blocks of very heavy design. These pillow blocks are bolted to the cross beams of the floor system, with packing pieces between them and the beams, and are lined up perfectly true and level. The thickness of the packing pieces varies to suit the requirements of each individual pillow block.

The end bearings, where the main shaft is geared to the diagonal shafts that connect it to the trucks at each end, are carried by compound boxes, so that it is impossible for the main and angular shafts to get out of line.

Special care has been taken with all the bearings to provide ample facilities not only for the lubrication, but for the inspection and removal of any part. For most of the bearings compression grease cups have been supplied, in addition to the usual lubricating holes and reservoirs.

The top of each truck carries a steel socket or cup, and in this socket is placed a hard steel ball, six inches in diameter.

The bottom of the end supports are also provided with corresponding cupped sockets. The ball rests in a slightly elongated groove; the major diameter of the groove being crosswise to the center line of the truck, and the minor diameter being parallel to the track on which the truck rests. By means of this elongation of the groove, the ball is allowed a slight motion at right angles to the center line of the track on which the truck travels, and this permits of the expansion and contraction of the main girders of the crane. It also allows the trucks upon which the crane travels to be slightly out of alignment, as the balls form universal joints between the trucks and the crane.

The arrangement of the gearing connecting the driving shafts to the trucks is such that the vibrations of the trucks around the centers of the balls do not disturb the alignment of the gearing to an appreciable amount, as the centers of the main driving spur wheels are on the same lines as the centers of the balls.

Directly in the center of the crane is placed a fifty horse power electric motor, connected directly to the main shaft with one reduction of steel gearing.

The trolley which travels upon the suspended runway beneath the main chord is of the ordinary crane type, with the exception that the gearing throughout is of extra heavy design, and of either steel or bronze castings.

The winding drum is of cast iron, with right and left hand grooves for the chain, milled out of solid metal.

The traversing of the trolley upon the track and the hoisting is done by two twenty-five horse power electric motors. All the motors are wound for 220 volts.

The operator's cage is attached to, and moves with, the trolley. It is provided with windows on all sides, so that the operator can have a clear view of any part of the yard. In the cage are placed the controllers which govern all the motions of the crane, and the necessary switches, cut outs, etc. Over all the gearing are placed coverings or housings that are readily removable, the coverings being arranged to exclude all moisture or dust. The motors are also incased.

Attached to each truck are two snow plows, or guards, made of plate stiffened with angle irons. These snow plows are easily removable, so that access can be had to any part of the trucks.

The end frames are so arranged that should it be desired to transfer a load from one side of the yard to the other, both cranes can be brought in line with each other by means of removable stops on the trucks, and the trolley from either crane run directly through the end supports and on to the track on the other crane.

## GOOD ROADS BY BAD MEN.

ACCOMPANYING is a picture of a road in North Carolina, made chiefly by convict labor. The load of cotton weighs 6,000 pounds. Many a farmer has had a hard struggle to haul two bales into a Southern town. This road is macadamized with three layers of broken stone of different sizes, well spread and packed. The picture is taken from the Year Book of the Department of Agriculture—an excellent volume that all farmers should obtain from Washington.

It is unquestionably true that the work of reforming the criminal, of which we must never lose sight by exalting the commercial motive, is entirely consistent with utilizing convict labor on the highways. There is a very large percentage of prison population for whom this would be the most desirable form of labor. By judicious selection of men, and by engaging them in small gangs upon the highways, it is probable that more wholesome influences might be brought to bear upon them even than in a well conducted prison itself. At any rate, here is an occupation which does not compete with honest labor, which is available for a great number of convicts to whom mechanical pursuits are not naturally adapted, and whose results would be in the highest degree beneficial to the State. We believe that further experiment along this line should be made at once, and that every State should attempt it. For our engraving and the foregoing particulars we are indebted to the Bicycling World.

ROADS BUILT BY CONVICT LABOR IN NORTH CAROLINA.

## CITY AND SUBURBAN HOUSES FOR THE PEOPLE.

WHEN the Tenement House Committee of 1894, Mr. Richard Watson Gilder, chairman, declared that New York possessed the worst tenement system in the world, the statement struck the community with startling force. It had long been known to a few, and vaguely suspected by many, that the wage earners of our city were compelled to live in wretched homes, but they were not prepared for so radical an assertion as this, backed up as it was by irrefutable evidence.

The investigation of the Gilder committee developed many interesting facts. It showed New York below the Harlem River to be the most densely populated city in the civilized world, and that a section 32 acres in extent on the east side, bounded by Second, Columbia, Rivington and Clinton Streets and Avenue B, with 986·4 persons to the acre, is by far the most congested district on the globe. It now, doubtless, numbers well above 1,000 to the acre. Bombay comes next with a district of 46·05 acres having 759·66 persons to the acre. The densest population of Europe is a small section of Prague (the Josefstadt) with 485·4 to the acre, while the most congested district of London has but 365 souls to the acre, only slightly more than one-third the number of inhabitants per acre in the similar district of New York.

In one wing of its investigation the committee found a population of 255,033 persons, out of whom only 306 had access to bathrooms in the houses in which they lived. Here is a population larger than Providence, R. I., Newark, N. J., Minneapolis or St. Paul, Omaha, Indianapolis or Kansas City, and but little smaller than Washington, D. C., or New Orleans, with only 306 persons able to take a bath in the house in which they lived.

The only public bathing facilities thus far provided are some feeble beginnings by charitable societies.

It is only fair, however, to say here that through the efforts of the Mayor's Committee on Public Baths, Dr. William Howe Tolman, secretary, the city of New York will have next year the first municipal bath erected in the United States.

In the same department of the investigation 15,736 families, numbering 60,897 persons, an average of 4⅕ persons to the family, were found living in tenements of an average size of 284·4 square feet of floor area. A fair idea of the awful contraction of these quarters can be obtained only by measuring an ordinary sized room. Under such conditions the death rate among children under five years of age runs up to 254·4 per thousand in the rear tenements of the First Ward, while under the most favorable conditions it is only 30 per thousand.

Under the same conditions, too, the general death rate rises from an average of 21·03 for the entire city to 61·97 and in some of the recently condemned rear tenements to 73 per thousand. Adequate experiments in many of the largest cities of the world have proved that this slaughter may be prevented by properly built houses, with plenty of light and air and generous bathing facilities.

For such miserable homes New York tenement dwellers pay an average rental amounting to 25 per cent. of the income of the entire family, while the same class of people living in the best model tenements of London pay for rent only from 15 to 20 per cent. of the earnings of only the head of the family.

These revelations have resulted in the organization of the City and Suburban Homes Company, which was promoted by the Improved Housing Council, Mr. Richard Watson Gilder, chairman, and Dr. William Howe Tolman, secretary. The council was the direct outcome of the Improved Housing Conference held in this city last March.

"Its objects," as stated in the prospectus of the company, "are to offer to capital what the directors believe to be a safe 5 per cent. investment, and at the same time supply to wage earners improved, wholesome homes at current rates. It will provide the very best accommodations from the standpoint of hygiene, and the largest degree of home comforts consistent with a fair return upon the capital invested."

The personnel of the City and Suburban Homes Company is a sufficient guarantee of its soundness as a business enterprise with philanthropic ends. The officers are: Dr. Elgin R. L. Gould, president; Mr. Samuel D. Babcock, vice president; Mr. Charles Stewart Smith, treasurer; Mr. R. Fulton Cutting, chairman of the board of directors.

Dr. Gould, late of Johns Hopkins and Chicago Universities, is very likely the best informed living authority on the housing question. He is the author of the "Eighth Special Report of the Commissioner of Labor: The Housing of the Working People," recently issued by the federal government. This report is the result of three years' close personal study of the housing question in Europe and America, by Dr. Gould, as the special commissioner of the United States government, and is doubtless the most valuable contribution yet made to the world's literature on this subject.

The council's Committee on Model Apartment Houses organized a competition of architects to secure plans for a block of city model apartment houses. The conditions were rigorously drawn to eliminate the existing evils of tenement construction and to secure for tenants the largest possible apartments, the best sanitary arrangements, family privacy, and the maximum of home comforts at rentals no greater than now paid, and at a cost to the company that would permit annual 5 per cent. dividends on the investment. The plans of Mr. James E. Ware and Mr. Ernest Flagg were finally adopted.

The chief objections to the old style tenements are, contracted quarters, lack of family privacy, and promiscuous toilet arrangements, inviting moral deterioration; lack of light and air and of sanitary accommodations, insuring a large death rate, and danger from fire—that ever present tenement horror. All of these are wickedly cruel when such houses are new; when they become old, dilapidated, infested with vermin and infected with disease germs, they are a disgrace to humanity and a menace, not only to the health of the unfortunate residents therein, but to the health of the whole community.

The unit of the plans of both Mr. Ware and Mr. Flagg is a building 100 feet square with an interior court about 30 feet square, ventilated to the street

either by narrow passageways or from the street through the basements; additional light, air and ventilation being provided by recessed courts 18 feet by about 60 feet opening from the street.

Each 100 foot building is divided into four compartments by unpierced fire walls running from cellar to roof. The structure will be either fireproof or of slow burning construction. The stairways will be fireproof and inclosed in fireproof compartments of brick.

In all of these buildings every room opens on an abundance of light and air. Everywhere there is cross-ventilation and plenty of light. Every apartment, whether it have two, three or four rooms, is complete in itself, with its private water closet, laundry, tubs, etc., while special attention is given to all the little "human nature" features, such as closets, pantries, dressers, mantels, etc., etc., so dear to the heart of every housekeeper, whether she lives in a tenement or a palace, and which add so greatly to the ease of making a home orderly, attractive and comfortable. The smallest bedrooms will contain seventy square feet of floor area and must be not less than ten feet in length by seven feet in width; and the smallest living room must contain 144 square feet. In addition to the laundry, gas will be introduced throughout the buildings. The company will light and clean the halls, courts, passages, etc. There is under consideration a system of gas ranges whereby housekeepers may have fire only when and in what quantity needed. This would certainly result in much cooler dwellings during the summer and would save a vast amount of fuel, trouble and work; it is probable that the company will supply hot water throughout the buildings without extra charge.

The City and Suburban Homes Company intends also to purchase suburban sites conveniently situated along lines of rapid transit, and develop them by building detached and semi-detached cottages which it will sell to the better paid class of wage earners on an installment plan more favorable than any yet in operation.

The method of operation will be as follows: The sites before being absolutely selected will be submitted to the judgment of would-be purchasers who will visit them and state whether they would like to live there. A location which pleases the majority will then be purchased. Applicants for homes, visiting the company's office, will select a type of house from plans presented for their approval. The company, when application has been made for perhaps twenty-five or fifty houses, will proceed to build.

When the house is ready for occupancy, the purchaser pays ten per cent. down, and selects a period of ten, fifteen or twenty years in which to acquit himself of his debt in monthly installments. The company also insists that he insure his life, so that in the event of his death, his family may be sure of retaining the home. The obligations of the insurance policy are assured by some well known life insurance company. The company attends to the payment of premiums, so that all the wage earner has to do is to undergo proper medical examination.

From the very first, the workingmen of New York City have shown a deep interest in the operations of the City and Suburban Homes Company. On one of the early Sundays of April last, Dr. Gould, now the president of the company, who was then engaged in directing the work of the Improved Housing Council, laid the whole matter before the Central Labor Union. This resulted in the calling of a mass meeting of the various federated bodies of organized labor, at which the Hon. Carroll D. Wright, United States Commissioner of Labor, presided, when the following resolution was passed: "Resolved, that this mass meeting having heard the explanation of the projects of the Improved Housing Council, approve the same and recommend the cordial co-operation of the wage earners of New York." The offices of the company are located at No. 281 Fourth Avenue, New York City.

## THE INFLUENCE OF STEEL CONSTRUCTION AND PLATE GLASS UPON MODERN STYLE.*

I MUST confess to a little doubt as to the intention of this inquiry. I shall, however, proceed upon the supposition that what is meant is to discover in how much and in what way the use of steel construction and plate glass has affected the forms of masonry design. It is evident, I think, that unless the employment of these agencies has caused some modification in the design of buildings where they are not employed, that their influence terminates in their own development, in which case they must be regarded rather as additions to the resources of modern design than as modifying factors in it.

An illustration will make this clear.

When the Gothic builders found a method of lightening their vaults by concentrating the weight on the ribs, and incidentally discovered the practical value of the pointed arch, a change in architectural style followed. The round arch soon disappeared even from walls unconnected with vaulting, and the new forms, introduced as engineering expedients, made their influence felt even in matters of pure decoration.

Now what we have to consider is whether the introduction of steel skeleton construction is going to produce a revolution in style at all comparable in nature to the one just instanced.

I think not. My first reason for thinking so is the direct one that I can see as yet no evidence of any change in masonry design which can, with justice, be attributed to the influence of steel framed buildings. The second reason is the theoretical one that the use of steel has introduced no new constructive principle. The way in which steel does its work is in no essential respect different from the way in which wood does its work. No different principle is involved. Steel has greater strength than wood, and it will not ignite, but that is practically the extent of the difference between them as constructive elements. Each requires some sort of protection from moisture and fire.

There is, however, one feature of steel framed buildings—I mean always those in which all masonry is carried on the framing—that might at some time become an agent in modifying the design of pure masonry facades, although it has not yet done so. I refer to the envelope which covers the steel framing. I have never particularly admired the paneling treatment of party-colored marbles given by Giotto to the Campanile at Florence, because its composition of lines fails to accuse the idea of solid masonry behind. It is too purely decorative, suggesting wainscoting, and is akin to the false treatment given many Italian church facades of the frontispiece type. In a word, it is not expressive in its suggestion.

Now the same reason which would lead one to condemn this veneer treatment for a good wall of masonry leads one to condemn a masonry treatment for what is really a veneer. The treatment that is wrong in the Campanile would be right in the steel framed facade.

This being so, it is possible that a time may come when the beauty of such a treatment of the envelope of steel buildings will so possess our minds that its influence will be felt in the design of masonry buildings. This possibility, however, is too remote to be reckoned as a present influence upon modern style.

Nor do I think plate glass can be counted as such an influence. It should be considered, like steel construction, rather an addition to our resources of design than as a factor modifying them. There is nothing in plate glass which compels our invariable use of it in large sheets, and so drives out before it the employment of mullions, muntins and leads. With steel construction we should have had the same great shop windows we have to-day, even if the casting of glass in plates had not been invented.

It must be conceded, however, that by reason of its mechanical perfection, its freedom from flaws and its admirable polish, plate glass exerts what influence it has to procure for it a setting in harmony with these characteristics.

Architecture has always been swinging back and forth between two extremes, which are marked respectively by indifference to mechanical finish and by delight in it. Your brilliant painter amazes his Philistine client by his unconcern about the finish of his brush work. The client sets smoothness of finish above the qualities the painter regards, because he is not a craftsman like the painter. The unevenness which the client finds a blemish may be to the painter the mark of his freest and truest touch. So there are certain types of architecture to which the individuality and touch of the craftsman lend a large part of their charm, whose very virtues are based on the happy use of the accidental, and whose effect is the opposite of formalism. These are the picturesque types. On the other hand are the formal types, where charm resides in the submission of all parts of the work to a central authority, and where the individual note in any part is a defect rather than a heightening of the general effect.

It is to this latter class of architectural styles that plate glass is naturally allied, by reason of having the same kind of virtues. It may be said, therefore, to be always silently exerting what influence it has in behalf of classical architecture. Yet I think this influence will not be considered great enough to modify our previous conclusion that modern style has been left unaffected by steel construction and plate glass.

* A paper by Mr. Robert D. Andrews read at the Thirtieth Annual Convention, A. I. A.—From the American Architect and Building News.

## AUSTRALIAN FROZEN FLOWERS.

AN Australian contemporary states that "the Victorian Agricultural Department is trying the experiment of freezing delicate flowers in blocks of ice with the view of sending them to London, in the hope that a small but, at the same time, profitable industry might be developed. It is readily admitted by the department that, even if the trial shipment is successful, the trade can never become a large one, as the expenses will be heavy, comparatively speaking, and render the bouquets costly when sold in London. Although the flowers will be a luxury, still there are wealthy people in London who will not grudge paying what would be considered here an extravagant price for them, seeing that our spring blooms will reach England in the winter months, when flowers are scarce. Flowers, especially roses, are obtainable in Australia nearly all the year round, and recently, although the Australian winter has fairly commenced, the department obtained a bouquet composed of chrysanthemums, violets, carnations, and other blooms, surrounded with maidenhair fern and Virginia creeper, and had it frozen in a block of ice. The bouquet was taken to the office of the secretary for agriculture to thaw, with the view of ascertaining if the flowers have in any way deteriorated or lost their perfumes through having been frozen. As far as could be seen through the semi-transparency of the ice, neither the shape nor the color of the blooms had been affected by being incased in ice." Without in any way wishing to discourage the growers in Australia in their efforts to find profitable markets for their produce, we are bound to say that the exportation of frozen flowers to Europe cannot become profitable. We question the probability of any demand for frozen flowers in this country, for, under the most favorable conditions, they are deprived of their attractiveness during the freezing process, and they involve much trouble. Presuming they should attain some degree of popularity, we have such an abundance of flowers here that we could freeze them and supply the blocks of ice in which they are embedded at a much less cost than could growers at the antipodes.—Gardeners' Magazine.

**A statement** recently published shows that during the first half of 1896 the wages paid in coal mines of Prussia showed a slight increase over 1895. The daily wages paid in the Dortmund district, the largest and most important, were: Miners, 92·4 cents; underground laborers, 64·8 cents; surface laborers, 67·4 cents; boys, 27·1 cents. Women are still employed in Upper Silesia to the extent of 7·5 per cent. of the total number, but in other districts they are only employed to a very limited extent, and in Dortmund and Saarbrück they are not employed at all. In the principal coal fields of Prussia—those of Dortmund and Saarbrück—the recognized duration of the shift is eight hours under ground. In the other coal fields the shift varies in duration from eight to twelve hours. In Upper Silesia 58·7 per cent. of the employes work for ten hours, 32 per cent. work for twelve hours and 9·3 per cent. work for eight hours. In Lower Silesia 84·5 per cent. of the employes work for ten hours and 15·5 per cent. for eight hours.

## SELECTED FORMULÆ.

**Marine Glue.**—The true marine glue is a combination of shellac and caoutchouc in proportions which vary according to the purpose for which the cement is to be used. Some is very hard and some quite soft. The degree of softness is regulated by the proportion of benzole used for dissolving the caoutchouc. Marine glue, according to Work, is more easily purchased than made, but when a small quantity is needed the following recipe will give very good results: Dissolve 1 part of India rubber in 12 parts of benzole, and to the solution add 20 parts of powdered shellac, heating mixture cautiously over the fire. Apply with a brush. The following is said to yield a strong cement: 10 parts of caoutchouc or India rubber are dissolved in 120 parts of benzine or naphtha with the aid of a gentle heat. When the solution is complete, which sometimes requires ten or fourteen days, 20 parts of asphalt are melted in an iron vessel, and the caoutchouc solution is poured in very slowly, in a fine stream and under continued heating, until the mass has become homogeneous and nearly all of the solvent has been driven off. It is then poured out and cast into greased tin moulds. It forms dark brown or black cakes, which are very hard to break. This cement requires considerable heat to melt it, and to prevent it from being burned it is best to heat a piece of it in a water bath until the cake softens and begins to be liquid. It is then carefully wiped dry and heated over a naked flame, under constant stirring, up to about 300° F. The edges of the article to be mended should, if possible, also be heated to at least 212° F., so as to permit the cement to be applied at leisure and with care. The thinner the cement is applied, the better it binds.—Oils, Colors, and Drysalteries.

**An Improved Liquid Glue.**—A German pharmaceutical chemist named Ernest E. Eduard Martens, of Neustadt-Holstein, has patented a preparation of liquid glass for joiners, upholsterers, etc., the object being to provide a strongly adhesive glue that will not be injurious to health. The process consists in dissolving ordinary glue in water, with the addition of sodium salicylate or of one of the compounds of the derivatives of the benzol group. One hundred parts in weight of the very best glue made from leather parings are placed in a suitable vessel and allowed to be softened in 150 parts of water, after which 10 parts in weight of sodium salicylate are added, the mixture being heated in a water bath until the solid part is thoroughly dissolved. To preserve the glue thus prepared, which remains liquid, one gramme of oil of cloves is added to each kilogramme of glue. This solution diluted with water forms a cheap substitute for gum, and can be used for all household purposes. The advantages claimed for this glue are that it does not require to be heated for use, and is entirely free from the objectionable smell of ordinary glue.—Oils, Colors, and Drysalteries.

**Process Work Collodion.**—A good formula for collodion to collodionize the glass plate to make a half-tone negative:

| | |
|---|---|
| Alcohol, 95 per cent | 8 ounces. |
| Ammonium iodide | 48 grains. |
| Cadmium iodide | 24 " |
| Cadmium bromide | 16 " |
| Pyroxyline | 120 " |
| Sulphuric ether | 8 ounces. |

Dissolve the salts by trituration in a mortar, each separately in a portion of the alcohol; add the pyroxyline and let soak a few minutes; lastly, add the ether, shake well, and set aside to ripen for about a day.—The Practical Process Worker.

**Simple Method of Drying Bottles.**—A rapid and simple method of drying bottles before filling them with powders or oils, etc., is to introduce an ounce or so of white mustard seeds, and rotate briskly. The seeds will absorb every trace of adhering moisture, and leave the bottle perfectly dry. This method has been used for many years in some large establishments, but does not appear to be so widely known as its convenience and efficacy deserve.

**New Method of Detecting Borax in Butters.**—The following simple method, depending on the production of the well known blue "bead," when borax and copper oxide are fused in contact, has been suggested by MM. Planchon and Vuaflart for the detection of borax in butter. Twenty grammes of butter are weighed in a porcelain dish, melted at a gentle heat, and dissolved in 10 cubic centimeters of petroleum ether. The solution is transferred to a separator and the capsule washed out with more petroleum ether, then with several successive 10 cubic centimeters of water. These combined liquids are well shaken together in the separator, and the lower aqueous solution run off into a platinum dish, at first gently warmed, as the trace of ether causes foaming, then evaporated to dryness, and incinerated. To the ash 0·5 gramme of pure dry carbonate of potassium is added, melted and allowed to flow over the surface of the capsule. A very small quantity of porphyrized oxide of copper is now added, and the mass again fused. In the presence of borax it will assume on cooling a more or less intense blue color. This test will show with ease the presence of two per 1,000 of borax.—Jour. de Pharm. [6], iv, 50.

**Gold and Bronze Paints.**—The liquid employed with which to mix the bronze powders (which can be bought of all grades and shades of color) is, for ordinary indoor work, dextrin (400 grains), containing potassium bichromate (1 gram) and sufficient water. Use 65 grains of bronze powder. For more permanent work dilute waterglass may be used. Borax-shellac solution, mixed with one-third alcohol, also is used, something like this: Bronze powder, 55 parts; alcohol, 10 parts; borax-shellac solution, 25 parts. Or dissolve dammar in benzol and neutralize with solution of potash by shaking together and allowing to separate.

**"Pole" Test Paper for Electricians.**—Unglazed porous paper is first moistened with the following solution: Phenolphthalein, 1; methylated alcohol, 10; distilled water to 100 parts, and dried. It is then again immersed in a 20 per cent. aqueous solution of sodium sulphate and again dried, and cut up into suitable small squares. On moistening the surface of this paper and bringing the ends of the wires on the moistened spot about half or one centimeter apart, a bright red spot will at once appear at the negative pole, due to the sodium there liberated. This reaction is obtained even with a very feeble current.—Annales de Chim. Analyt., i, 270.

## ENGINEERING NOTES.

**There has** this week been opened for regular traffic the western section of the Siberian Railway from Cheliabinsk to the Obi, 889 miles in length, with a branch of 158 miles from Cheliabinsk to Ekaterinburg. A new section of the Transcaspian Railway, running 48 miles from the port of Krasnovodsk, on the Caspian, to the main line to Samarkand, has also been opened for traffic.

**Dispatches** from Dalles, Oregon, state that the government locks around the Cascades in the Columbia River were opened November 5. Excursion trains and boats from Portland and other points brought many visitors and various government, marine, county and railroad officials to the city. The locks have been under construction for three years and cost $3,800,000.

**One of the** large machine mines in Illinois has a very useful as well as unique power hammer in its blacksmith shop. An old type of percussive air driven mining machine has been erected in a vertical frame and a heavy hammer fitted to the piston. A lever controls the admission of air, and the work performed is very satisfactory, the machine doing as much as three blacksmiths did previously.

**The Harlem** River ship canal project, proposing deep water connection with Long Island Sound, is to be again presented to Congress, with a bill asking for $2,500,000 for this work. This canal would be 3,400 feet long, improving Bronx Kills, a shallow watercourse about 300 feet wide connecting the Sound and Harlem River around the north end of Randall's Island. The proposers of this enterprise claim advantages for a Sound entrance for ocean steamers, and contend that the demand for another entrance to New York is already apparent in the crowding of the lower bay. The improvement would doubtless be advantageous to property on the Harlem, or rather Port Morris water front.

**An accident** happened to a passenger elevator in the twenty-two story office building of the American Tract Society, Nassau and Spruce Streets, New York, on November 14, by which one man had both knee caps fractured and ten others were badly shaken but not seriously injured. The car was descending and was about to stop at the tenth floor when the operator found that his lever had no control over the car. It continued down the shaft at a speed considerably higher than the normal, but yet not high enough to throw into gear the automatic catches, and struck on the rubber buffer stops at the bottom of the shaft in the cellar, rebounding several feet. The cause of the accident was the breaking of one of four bolts in the cover of a check valve located in the pipe running between the hydraulic pressure pump and the hydraulic cylinder, which allowed the gasket of the cover to blow out and the water to leak out of the cylinder through the opening thus made. A high pressure hydraulic elevator plant is in use in the building, the pressure being about 900 pounds per square inch. It is believed by many engineers that the high pressure system is a failure.

**Few users** of wire rope and flat cable realize that these are machines with many moving parts, each requiring lubrication, says the Engineering and Mining Journal. The common notion is that a lubricant for wire rope should be merely some sort of thick tarry stuff to act as a preservative against rust and in part to protect against wear. As a matter of fact, every time the rope goes over a sheave each strand and wire is chafing against others and the hemp core (in case of round rope); hence the need of a thorough interior lubrication. It is evident that a mere surface coating will not answer, so that any substance which, like linseed oil, hardens and strips is not a proper lubricant. Various compounds and mixtures of different materials are in use, more or less satisfactory and more or less expensive. The Roeblings have been advising the use of a mixture of mica, axle grease, tar and summer oil. This is unpatented and can be made of any desired consistency. The tar and oil must be free from acid. It is claimed that it thoroughly penetrates between the wires, prevents rust and fills the cable, resists water, does not strip and is very economical if added sparingly, as all lubricants should be, after the first dose. It goes without saying that cables well taken care of will last very much longer than neglected ones; besides which there is the far more important matter of safety in mine hoists to be considered, one condition of this being the clean state of the interior wire surfaces.

**Compressed** air motors form the subject of a late letter from Paris to the New York Evening Post. The Mekarski system, introduced at Nantes in 1879, includes the storage of air compressed to twenty-five atmospheres in reservoirs under the motor car. This air, passing through a regulator, is reduced to a pressure of five atmospheres in the working cylinders, and the loss of energy in this reduction, estimated at 38 per cent., is met by a reheating of the air before it enters the cylinders. The Mekarski system of motors is now used on the line from Nogent to Bry, on the Marne, from the Louvre to St. Cloud and to Versailles; and from St. Augustin to Vincennes. The objections to the system are the dead weight of the motor car and its reservoirs, amounting to from 4 to 10 tons, and the necessity of going to a central station for recharging. Otherwise the system works well and grades of more than 6 per cent. are readily overcome. M. Popp, of the Compagnie Parisienne d'Air Comprime, now proposes to establish lines of piping carrying compressed air and so arranged as to charge the car reservoirs at short intervals along the route, and he has already laid down 2½ miles of such a line, furnishing air at ten atmospheres in Saint-Quentin. He would thus do away with the heavy reservoirs on the motor car and claims a loss of only 1 per cent. in transmitting the compressed air 2½ miles, with a plant costing about the same as for electric traction, both for compressors as offsetting dynamos and pipes as offsetting overhead wires and their supports. The extreme cost price of the Mekarski system, as originally used, is set down by this correspondent at 7 cents per kilometer per motor car, or 11·3 cents per mile, including the compression of the air, repairs, maintenance, interest, sinking fund and profit to factory. This is compared with 17·7 cents per mile for horse tramways in Paris. When the motor hauls another 50 passenger car, the supplementary expense is 3·2 cents per mile. In Belgium, where labor and coal costs half as much as in Paris, the cost goes down to 6·4 cents per mile for the motor car.

## ELECTRICAL NOTES.

**The Osaka**, Japan, Electric Copper Refining Company has recently paid a yearly dividend of 12 per cent. to its shareholders.

**An electric** pacemaking machine was tried in London recently on the Crystal Palace track, and reports state that it proved unusually successful.

**Work** has been begun on an elevated electric railway in Berlin, Germany. The well known firm of Siemens & Halske is building this road.—Elektrotechnische Rundschau.

**Electric** street cars in Berlin, Germany, will be propelled by means of storage batteries in the central part of the city, while trolley lines, with overhead conductors, will be used in the outskirts of the capital.—Uhland's Wochenschrift.

**Gebrueder Naglo**, of Berlin, Germany, have constructed a telephone exchange of a new type, which permits of using only one central for 40,000 to 50,000 subscribers. Small incandescent lamps are used to indicate calls and the making or breaking of the connection. The new system is expected to bring about a considerable saving in the number of central stations and employes, also in the time necessary for effecting connections.—Elektrotechnische Rundschau.

**Kingston**, the capital of the British West Indies, with a population of about 50,000, is going to put in a trolley system. The Jamaica Street Car Company, Limited, has applied through the Hon. S. C. Burke, its president, and Mr. H. E. Squire, its secretary, for permission to equip the lines electrically. About ten miles will be built. The company is an old and prosperous one, having operated for many years past, using mules as motive power, says the Electrical Engineer.

**There** is a certain amount of novelty in a new ozone generator, which was recently exhibited before the Paris Academy of Science by Gaston Séguy, says the English Electrical Review. The generator consists of a glass tube containing seven narrow tubes, each of which has a spiral of aluminum wire inside and outside. The inside spirals are all connected with a single wire which passes to the outside of the tube, while the external spirals are similarly connected with another wire. These wires are respectively connected with the two poles of an induction coil. In using these generators, three or more may be connected in series, and Séguy states that when operating with air, as much as 170 milligrammes of ozone per hour can be obtained, and that this amount rises, in the case of oxygen, to 250 milligrammes per hour.

**At a recent** meeting of the Physical Society, Prof. W. Stroud read a paper, by himself and Mr. J. B. Henderson, on "A Satisfactory Method of Measuring Electrolytic Conductivity by Means of Continuous Currents." The method consists in placing a balancing electrolytic cell in the arm of the Wheatstone's bridge, adjacent to the arm containing the chief electrolytic cell, so that the electromotive force of polarization in the two cells neutralize each other's effect on the galvanometer. The authors find that if the resistance of the arms of the bridge be high—20,000 ohms—and if an electromotive force of about 30 volts is used in the battery circuit, then the resistance of a solution of potassium chlorate in these experiments can be determined to within about one part in 2,000. With a D'Arsonval galvanometer the balancing cell is so efficacious that it is impossible to tell that it is not a metallic resistance that is being measured.

**Still another** metropolitan electric railway project for London, says the Engineer. A correspondent of the Times says that a strong private syndicate has been formed, the promoters of which will have from three to three and a half millions sterling at their command, to construct a line from Hammersmith broadway to Cannon Street. The total length of the projected line is about six miles, and the method of construction substantially the same as that of the City and South London line. From borings taken it is stated that no engineering difficulties are anticipated. The route to be traversed is substantially as follows: Starting at the south corner of Bread Street, and under Ludgate Circus, the line passes under and parallel with Fleet Street, under the Strand to King William Street, under Trafalgar Square and Piccadilly Circus, and thence follows the line of the high road to Hammersmith. The trains are to be made up of corridor carriages built on the tramcar principle, with platforms at each end. These carriages will be 45 ft. in length, containing seats for forty-eight passengers. Seven of them will make up a train, which will thus accommodate 336 persons. The journey from one terminus to the other will take not much more than half an hour, including the stoppages at each of the twelve intermediate stations. It is calculated that the expense of construction, including the stations and the general equipment of the line, will come to about £500,000 per mile.

**The** Electrochem. Zeit., for October, contains a short article describing some experiments on the electrolysis of milk, says the Electrical World. With two platinum electrodes the anode was covered with a white spongy material which floated to the top and consisted chiefly of caseine and fat, and the milk was slightly alkaline after the operation; by continuing the process it was possible to withdraw practically all the solid material, leaving a translucent liquid, and there was no noticeable deposit on the negative electrode; the action was quite local and the froth at the negative electrode caused by too rapid electrolysis was strongly alkaline. Another experiment made under the microscope showed a yellow precipitate on the anode; an acid was formed at the anode and an alkali at the cathode. By electrolysis the action which takes place in the milk when exposed to the air can be altered by separating a part of the whole of the caseine from the milk. He tried the Andreoli method of "indirect electrolysis," placing the milk in the middle portion of a vessel which was divided into three parts by metallic partitions, the two outside portions containing a solution of salt; a precipitate was formed in the middle portion on the side toward the anode; when all three compartments contained milk the deposit appeared on both of the walls of the middle compartment. Some experiments were made to preserve milk by extracting a part of its caseine electrically, but without success.

## MISCELLANEOUS NOTES.

**The automatic** machine idea has been turned to new account in Italy. Put a coin in the slot and take out a receipt and the thing is done. The workingman's "honest penny" is banked without the trouble of going to a savings bank or postoffice. When a sufficient number of receipts have been collected they can be exchanged for a "libretto" at the regular savings bank. Interest at 4 per cent. is paid on deposits, and the depositors are entitled to a share of the profits derived from the bank's operations.

**The** death took place recently in Sweden of Robert Nobel, the pioneer of the naphtha industry in the Caucasus. A casual visit of the Swedish manufacturer to Baku, in 1873, led to his great discovery. He explored the Apsheron Peninsula and discovered rich deposits of petroleum. The abundant supply showed him that Russian petroleum could compete with American, and, taking into partnership his brothers, Alfred and Lewis, he founded, in 1875, the great firm and manufactory which was the first step toward establishing the present prosperity of the Caucasus.

**The urban** population of the United States is discussed in Scribner's for October. It is stated that more than one-third of this total population now live in cities. In some States this percentage is much exceeded, as it is 70 per cent. in Massachusetts, 60 per cent. in New York, 54 per cent. in Connecticut, and 52 per cent. in New Jersey. In 1790 there were only six cities of more than 8,000 inhabitants; in 1890 there were 448 such cities. In 1840 there were only three cities with more than 100,000 inhabitants; in 1890 there were 28 cities of this population. In 1896 the 3,200,000 inhabitants estimated for the Greater New York almost equal the population of the thirteen United States in 1789.

**Under** date of September 26, Consul Monaghan, of Chemnitz, says: "In 1895, Germany used 733,000,000 cubic meters of gas, to produce which she burned 55,000,000 centners of coal. The number of lights was 5,734,762 (she has, besides, 95,000 16 candle power electric lights furnished by 180 electric plants). She has 15,644 gas motors, giving 52,000 horse power. She uses gas for light and fuel, that is, for heating and cooking purposes. It seems to me that much might be done to put American gas stoves on the German market, as all I have seen are much dearer than equally good, if not better, ones in the United States. The Berlin city gas plant produced 103,913,000 cubic meters in 1895, against 74,337,000 cubic meters in 1885, and an English company in Berlin, 32,282,000 cubic meters in 1895, against 30,960,000 cubic meters in 1885."

**Grass** will grow on a railway bed if the ties are covered with soil and seed sown. This can be verified by a visit to the Fairmount Park trolley line, near the Belmont Avenue entrance, says the Philadelphia Times. This section of the track resembles two parallel rails laid through a green meadow, and the presumption is that the railway management intend to make the entire track from end to end like it. If the grass can be kept green in dry as well as wet seasons, the presence of the track will hardly mar the landscape at all. Even the poles and trolley wire are not as unsightly as the electric light poles and wires which have been allowed to disfigure the park in every direction. There is a possibility, of course, that the grass between the tracks may prove a hindrance to the operation of the line, even if it is ornamental, but this is hardly probable if the grass is kept well mowed. A railway line with no ties in sight and carpeted with a luxuriant greensward will be a novelty at least.

**Gloucester**, England, is the center of the anti-vaccination crusade. The anti-vaccinationists gained such influence that vaccination was largely disused. For the past ten years, of the 15,682 children born, only 2,378 were vaccinated. The public officials were members of the Anti-Vaccination Society. But recently the smallpox appeared; in a population of about 40,000 there were 2,036 cases of the disease, being about five per cent. of the population. The deaths were 443. In reply to those who charged this disastrous effect upon the disuse of vaccination, it was alleged that the sanitary condition was bad. This, however, is denied by the city surveyor of Gloucester, who was for many years an anti-vaccinationist; the usual health of the city, judging by the limited extent of infectious sickness, was exceptionally good. The number of children under ten years of age who were attacked was 714, of whom 25 had been vaccinated, 688 unvaccinated, one uncertain. The deaths among this number were, of the vaccinated, one, of the unvaccinated, 279. As a result of the recent experience vaccination has been generally resorted to, and there have been, within a short time, 25,980 vaccinations and revaccinations in the city and suburbs. As a result the disease has been stamped out.

**There** are many books of reference, like dictionaries and the Bible, which are consulted not only frequently, but also in a hurry, by professional men. Without proper guides to the particular spot you are hunting for a good deal of time is spent needlessly in such work. An attempt has been made to reduce this waste by notching the edges and stamping letters or abbreviations on the sides of leaves to indicate the beginning of some alphabetical or other division of the work. Blank books are often prepared in this way. An inventor has given this subject much attention, and has taken out various patents on new indexing systems during the last seven or eight years, all of which are designed to get rid of cutting the leaves or affixing tabs. His latest plan consists of a printed tabular index on the front edge of the closed book. In several vertical columns on a dictionary say, he places symbols like "Ab 7" "Ac 9," "Ad 17," "Da 330," "Def 344" and "Dia 367." So long as this index remains legible one can readily ascertain from it at a glance the number of the page on which the desired information is to be found. The system is susceptible of rather extended application, and is supplemented by another useful feature. The uppermost quarter of an inch of the front edge of the closed book is divided into blocks of 100 pages each, and these are numbered "1" "2," "3" and so on, so that having found, for instance, that words beginning with X are to be found at page No. 937, one can aim with accuracy at the right place the first time the book is opened. The inventor thinks that this plan is well adapted even to courthouse records.

## SOME CURIOUS WATCHES.

IT is interesting to study the transformations that have taken place in the form of certain pieces of watchwork at epochs remote from each other, and to observe how they come into fashion again either in an improved or decadent state. What is no less curious is to see how frequently an object that has been repeatedly made in days of old becomes a new invention, or at least is sincerely thought to be so by the manufacturer, owing to his ignorance of history. How many reminiscences in watchwork have been given as innovations? We shall point out a few types that have been made over and over again in various forms from the sixteenth century to our own day.

One "new" method has been to place a watch in the cover of a card case having the form of a book. Such cases, of a more or less valuable material, have not much decorative character, and the circular dial of white enamel, placed in one of the corners of the book and offering the aspect of a large wafer, does not concur much toward heightening the effect of it.

How far removed are such cases from the pieces made in the same order of ideas in the sixteenth century! The book that we illustrate in Fig. 1 belongs to the collection of Mr. Paul Garnier, and is in so perfect a state of preservation that it might be thought to be new. It is one of the finest German types that we have ever seen. It was made in 1583 by Hans Schnier, in Speir. This superb book is of gilded copper. It is 4½ inches in length, 2¾ inches in width and 1 inch in thickness. Its cover, ornamented with engravings and with rosework in relief, and the two clasps of chased copper, give it a character of great richness.

The circular openwork parts seen in the right hand side of the cover amid engravings representing flowers and fruit are designed to allow of the passage of the sound of the bells placed immediately beneath.

This face, taken as a whole, is really superb, with its engravings, its openwork and its chasings in relief. All this decoration is beautiful, although the design is not irreproachable.

Amid engravings of the same character, there is on the left hand side of the cover a sun dial with a jointed style. A compass is placed at the side to orient it. This is movable, so that it may preserve the horizontal position necessary to it and so that, upon being turned upside down, its engraved bottom may complete the external ornamentation of the face. The bevels observed upon the edges of the cover further improve its finish. The rounded back of the book is in no respect inferior to the plane faces. It is engraved with the same care, as are also the edges; and openwork formed amid the ornaments serves, like that of one of the faces, to allow the bells to be heard more distinctly.

Upon one of the internal faces of the cover are represented two allegorical figures placed in small arcades and surrounded with flowers and fruit. These same ornaments are found in the interior of the other side of the cover and upon the gilded copper pillar plate of the movement. We find, also, two dials, the upper one of which is composed of two concentric disks, the external one carrying the twenty-four hours of the entire day, and the internal one, which is movable, serving to regulate the alarm.

The lower dial also has two disks, the external one of which is divided into four periods of four, indicating the quarters struck by the movement placed behind. The internal one marks the ordinary hour. The small dial to the left indicates the phases of the moon, the day of the month and the procession of certain stars. That to the right serves as a receptacle for the compass and marks the fractions of the quarters. It is divided into eight parts.

There exists also another of these books belonging to the same collection, and which is considerably smaller and simpler than the preceding. The engraving, with deepened enamel of the gilded dial plate, although simple, offers, with the dial itself, which is of silver, a charming ensemble. Upon each side of the cover are engraved allegorical figures in cartouches.

These books sometimes had a glass inserted in the cover in order to allow the hour on the dial to be seen without rendering it necessary to open the book. These date from the beginning of the seventeenth century.

In certain others there existed quite a curious arrangement in the cover for allowing the hour to be seen without opening the book. It consisted of a rose ornament of the diameter of the dial and divided into twelve sectors, in openwork, corresponding to the hours, thus permitting the hand to be seen in its travel.

There were also covers that had a protuberance opposite to and of the same diameter as the dial for the passage of the hands. This replaced the convex glass without possessing its advantage. All such pieces were more or less engraved and chased. They were, upon the whole, true objects of art more interesting than our card cases, which, despite the twofold purpose for which they are designed, are nevertheless books giving the time brought into fashion after a lapse of three centuries.

The ring placed at the upper part of the olden books would seem to indicate that they were worn like watches. But we do not think that this is so, at least as regards some of them. They must rather have been designed for home use, as in the case of other pieces constructed under the same conditions, and which were certainly not worn, despite their form, which nevertheless would have adapted them for such a purpose. Thus, for example, in the sixteenth century, clocks were made in the form of huge watches. We possess one that is 5½ inches in diameter and weighs more than two pounds. These figures evidently show that it must have been designed for house use.

At the end of the sixteenth century there existed at the city hall of Paris, in the room in which the municipal officers met, a large watch inclosed in a red morocco leather case.

It is therefore probable that the same was the case with the books, which, in most instances, must have been used as table clocks.

Again, from the collection of M. Garnier, we represent (Fig. 2) a "monster clock," as such pieces were called in the sixteenth century. It is a sphere of gilded copper slightly larger than it is shown in the engraving.

It opens in two equal parts, as shown by the hinge, and is kept closed by means of a simple hook. It is signed "Jacques de la Garde, Bloys, 1551." Its state of preservation is perfect, and it is very interesting by reason of its decoration and especially of its form, which is very rare for the epoch.

The engraving of the finely designed arabesques is very beautiful. The openwork observed in the upper part is designed to allow of the passage of the sound of the bell, for this piece has a striking train. The dial, although simple, is boldly engraved. The ring through which the watch was carried is attached to a finely chased base of a remarkable pattern. It still possesses its old-fashioned key and the bag in which it was inclosed.

If we turn from the sixteenth to the nineteenth century, we shall find the same form of watch again, but regarded as a novelty. In fact, about twenty-five years ago, watches were made that consisted of two hemispheres of flint glass set in a bezel of metal and in the center of which was placed the movement. They were ugly and devoid of character, but there was a certain demand for them. Soon afterward, however, spheres of this kind were made of gold with jewels, enamels, etc., that were and are still (for they are yet in fashion) beautiful ornaments.

The mention of the fact that the Renaissance spherical watch was carried by means of a ring leads us to say a word as to the old method of carrying watches as compared with the present one. The great lords and ladies of the time wore the watch suspended from the neck outside of the clothing. That must have been pleasing, especially when it was a question of Gabrielle d'Estrée, for example, who wore "a monster of gold with a quantity of diamonds and rubies," as we are told in an inventory of her property drawn up in 1599.

This fashion was much preferable to that in vogue among our modern ladies, who wear the watch suspended from the neck inside of their gowns, thus allowing only a short and slender chain to be seen.

The watches with which the heads of canes and umbrellas have been ornamented for the last fifteen years, and which made a sensation when the fashion appeared, had already a long history, and although the idea was patented, the patent had no value, for in 1545 Parker, Archbishop of Canterbury, bequeathed to his brother Richard, Bishop of Ely, a cane that had a watch set into the head.

During the seventeenth and eighteenth centuries, the cane, which was in so great favor, and which was carried with so much ostentation, was more than ever adapted for the setting of watch movements into the superb gold and silver heads that ornamented them (Fig. 3, No. 1).

Under the empire, although the cane had lost its splendor, there were some still made with watches.

As long ago as the sixteenth century, watches were also set into rings, which have never ceased to be made since, although the decorative details have of course been modified according to the style of the epoch. In Fig. 3, No. 2, is reproduced an engraving belonging to Mr. Garnier and signed Woeriot, designer, goldsmith, chaser and engraver, born in 1532.

In 1542, Duke of Urbino, Guidobaldo della Rovere, owned a ring provided with a striking watch, and, later on, Anne of Denmark, who in 1589 was married to James I, King of England, had one whose crystal glass bezel case contained a movement that struck the

FIG. 1.—CHASED AND GILDED COPPER BOOK, WITH A WATCH IN THE INTERIOR.

FIG. 2.—SPHERICAL WATCHES.


FIG. 3.—1. HEAD OF A CANE CARRYING A SMALL WATCH. 2 AND 3. WATCH RINGS. 4. WATCH OF THE SEVENTEENTH CENTURY. 5. WATCH OF THE EIGHTEENTH CENTURY.

hour, not upon a bell, but upon the finger, which was gently tapped by the hammer. Such rings continued to be made in the succeeding centuries. We read in the Dauphin almanac for 1772 that Tavernier, a watchmaker of Bussy Street, "was one of the most renowned for watches in rings, bracelets, cane heads and other objects of smaller caliber." At the same epoch, Divernois, another watchmaker, even set repeating watches into rings. In Fig. 3, No. 3, is represented one

FIG. 4.—WATCH IN A GOLD CASE.

that belonged to a great collection of Paris now dispersed.

We still find some of these watches of past centuries. They are very finely executed and constitute valuable ornaments. The most decorative are those of the eighteenth century, of rectangular form, called "marquises." The others had circular bezels, and were the ones that were made primitively, and that are still made. Like Tavernier in the eighteenth century, who made watch bracelets, our modern watch makers also have introduced the use of them. Very fortunately, these are not all like those ugly strips of leather that a new fashion calls bracelets and into which a watch is set. On the contrary, there are some made that constitute very elegant jewels of gold, with gems, enamel, etc., and into the ornamentation of which the watch very naturally finds a place.

Very probably these watch bracelets are not inferior, from an artistic view point, to those of the past century, the only difference being that the watch was formerly hand made, while the parts are now turned out in large quantities by machinery.

During the eighteenth century, carriage timepieces were made that obtained the name of "berline watches." They offered a certain contrast with the common nickel-plated watch that is now inclosed in a small leather case, and that might be called a piece of harness. It is away behind its centenary ancestor, which was both an object of art and utility, and which was remarkable by its decoration and complications as well as by its material. The complications, it is true, would now be perfectly useless, since carriages are no longer used except for excursions and for taking an airing, and not for traveling, and since striking trains and alarms would therefore have no raison d'être. But decoration and good taste in the form should have their place in these objects now to as great an extent as they did in former times.

Such timepieces of the last century proceeded from the big table watches of the end of the sixteenth century, of which we have above spoken. Like them, they were of huge proportions. In most cases they were made of silver, cast and either chased or engraved. The motives were either mythological scenes or contemporaneous figures. In other cases they were merely ornaments, but extremely rich in design. Beautiful openwork scrolls ornamented their cases and permitted the sound of the bell placed in the interior to make itself more distinctly heard. The movements were covered with finely finished pieces and with handsome designs, and also with pieces of copper that were marvels of engraving, and with open tracery so delicate that it might have been styled gold lace. They struck the hours and quarters, were provided with an alarm, and could be made to strike at any time through a long silken cord terminating in a small metallic ball and pulled by the persons occupying the carriage. The ring that served to suspend the watch was itself often very curiously jointed and so constructed that it was possible to turn the piece in all directions if it were necessary to see the hour upon the dial, and that, too, whatever was the position occupied by the persons in the carriage. The dials were generally composed of an enamel disk. The dials made entirely of metal were rare in France, since berline watches were then made everywhere where watchwork was manufactured.

Such pieces were also formerly inclosed, but in this event it was in cases that assumed the form of the watch and that were made of tortoise shell, sharkskin or hide and ornamented with silver nails so arranged as to form handsome ornaments. This kind of watches was used in France up to the revolution, and in other countries until railways suppressed traveling in coaches

The berline watch was succeeded by the traveling clock, with its glass case mounted in a frame of gilded copper. It is still called a traveling clock, although it is scarcely used any longer for the purpose for which it was designed, since it is too cumbersome. It is less so, however, than the traveling clock of Louis XI, which was inclosed in a trunk and placed upon the back of a horse. Martin Guerrier, the driver of the animal, received five Tours sous a day for himself and his nag. It was the latter that was really cumbersome!—Planchon, in La Nature

## THE CALLENDAR & GRIFFITHS SELF-TESTING RESISTANCE BOX.

WE illustrate below the self-testing resistance box and bridge of Messrs. Callendar & Griffiths. The designers have perfected the measurements of electrical resistances to a degree hitherto unattainable, and the fact that the bridge is self-testing renders it particularly valuable for scientific determinations. With the help of this bridge and their platinum coil thermometers, the designers have been able to measure very high temperature, as we have pointed out loc. cit. The whole instrument (Figs. 1 and 2), including the glass case which protects the top, is 33 inches high, 24 inches long, and 16 inches wide. The box top is made of white marble; the sides and base are formed of two sheets of copper separated by asbestos, so that the inner surface is kept at a nearly uniform temperature.

All coils are of naked platinum-silver wire, wound on open mica frames. If the box is lifted out of its case, which can easily be done without removal of screws, etc., all coils can be seen, and are readily accessible. When in situ, they are immersed in non-volatile hydrocarbons without taste or smell, and of high insulating power. By moving a handle at the side of the case, a stirrer passes across the tank. There is hence every provision taken to insure that the temperature indicated by the thermometer in the oil is that of the coil. This point, however, requires very patient care, as Mr. E. H. Griffiths, F.R.S., himself explained at the Liverpool meeting.

The actual temperature coefficient of the coils can be determined in situ with certainty over any given range. By warming the oil bath, the coils can be heated, and thus a resistance be determined at two known temperatures. This arrangement is far superior to the usual practice of embedding the coils in paraffin or shellac, when their temperature may greatly differ from that of the thermometer. Any changes in the coils are easily detected. As they are very thoroughly annealed, however, by heating them by means of an electric current to bright red in an atmosphere of carbonic dioxide after adjustment, the coils are likely to remain constant.

The unit of the box is 0·01 ohm. The smallest coil has a value of five such units. Each coil is double the one preceding it; the values are:

| A. | B. | C. | D. | E. | F. | G. | H. | J. | K. | L. |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 10 | 20 | 40 | 80 | 160 | 320 | 640 | 1280 | 2560 | 5120 |

These numbers and letters are engraved on each block. The chief advantage of adopting this binary scale is that the observer acquires the power of testing the coils, for each should differ by a fixed quantity from the sum of those beneath it. Two additional coils are inserted, one marked "cal," value 1 unit, for the calibration of the bridge wire itself, and one marked "$\Phi$," value 100 units, which serves for observations with the platinum thermometer.

Fig. 3 illustrates the connections. The ratio arms, $S_1$ and $S_2$, are equal; their equality can easily be tested by the box itself, and an adjustable potential contact is provided, by which the observer can secure exact equality. This is necessary, as any inequality in these coils involves somewhat lengthy arithmetical corrections. In boxes with ratios 1,000: 10, e. g., on the other side, a small error in the lower arm causes a serious defect. By placing between $C_1$ and $C_2$ compensating leads, whose resistance is equal to those connecting the object with $P_1$ and $P_2$, the actual resistance of the leads in no way affects the readings, and if two pairs of leads are placed together, the observations are also unaffected by changes in their temperature. The vernier reads to 0·00001 ohm. For this degree of accuracy it is necessary to eliminate thermo-electric effects by means of Griffiths' thermo-electric key;* the thermal effects due to contacts in the box are, however,

*See Phil. Trans. Royal Society, vol. 184, A, p. 398, 1893.

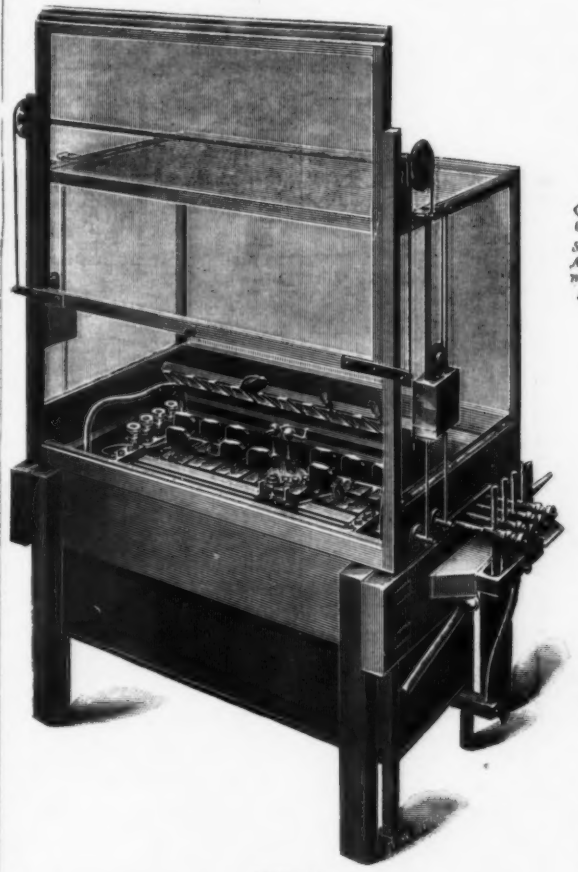


FIG. 1.

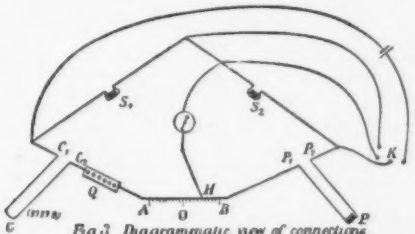
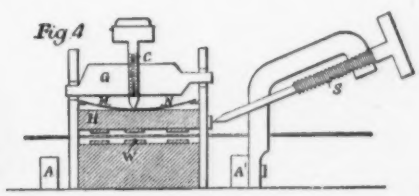
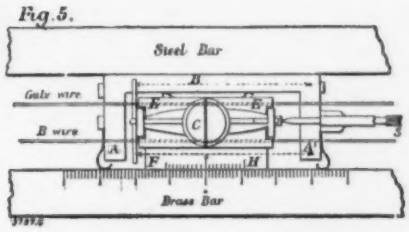



Fig 3 Diagrammatic view of connections
S, S2 are the ratio arms of the Bridge Q Set of Resistance Coils
A B the Bridge wire K Thermo electric Key P the object to be measured P P2 Terminals C, Compensating Leads C1 C2 Terminals H, Sliding Contact on Bridge Wire



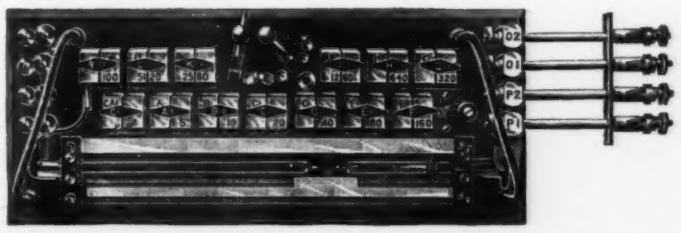




FIG. 2.

THE CALLENDAR AND GRIFFITHS SELF-TESTING RESISTANCE BOX.

almost negligible. Any resistance exceeding 0·3 ohm can be taken in three different ways. Special attention has been paid to the plugs. If a plug is kept clean and screwed round on insertion so as to scrub the surfaces, the contact is satisfactory. In ordinary boxes, owing to the elasticity of the box top, the constant of any plug is affected by the insertion or removal of its neighbors. The dial pattern is superior, but the majority of its plug holes are always open and exposed to dust and oxidation. In this box separate brasses are used throughout. When withdrawn from their brasses the plugs are placed in a spring rack, so contrived that the insertion has a cleaning effect on the plug surfaces. When not in use, all plugs should be kept in their brasses. No part of the plug is larger than the top of the plug hole, so that no shoulders can be worn, to be aggravated by grinding.

By means of a key the resistance in the battery circuit can be broken or altered from 20 to 100 or 500 ohms; thus the potential difference at the bridge end can be changed without altering the battery connections. Resistances of less than 0·05 ohm are determined by the bridge wire. The special contact maker for fine adjustment is very ingeniously designed. It is shown in section in Fig. 4 and in plan in Fig. 5.

A B A' is a brass framework, sliding between the steel and brass bars; an inner block, F E E' H, stands inside the brass frame with a play space of about one centimeter at its ends. Springs, A and A', press the brass frame against the steel bar, and springs, E and E', the inner block against the front brass bar. Thus the pressure of the brass frame against the steel bar is the sum of the pressure of springs, A, A', E, E', while the pressure of the inner block on the front bar at F H is the sum of E and E' only. If, therefore, the screw, S, is rotated, the inner block alone is moved. As the screw, S, recedes, the inner block is made to follow by means of long springs indicated by the dotted lines with arrows of Fig. 5. If, by inadvertence, S should be turned when the bridge wire has not been released by the screw, C (Fig. 4), then the outer framework, A B A', moves instead of the inner block. The arrangement by which the pads in the block, H, can either be pressed down for temporary or be screwed down for more permanent observations is shown in Fig. 4. The spring, M N, lifts the pad off the bridge and galvanometer wires, which, therefore, do not touch the cross wire, marked in section at W, unless a downward pressure is exerted on the block, H. By holding the head of the screw, S, the contact maker can be pushed to any desired position. A movement of two centimeters of the contact maker on the bridge wire corresponds to one box unit. Injury to the bridge wire is almost impossible, even if roughly used. F H is the vernier.

The bridge wire is supported in such a manner that its tension is not affected by temperature changes. The same applies to the connection with the scale; the zero readings remain absolutely uninfluenced, and at the extreme ends of the scale a temperature variation of 20° C. would not affect the readings by as much as 0·00001 of the scale. On each side the bridge wire is protected by heavy metal bars, and further by the glass case. Resistances from 0·00001 ohm to 105 ohms and more can directly be read by a "null" method without observation of galvanometer swings. The fine adjustment and the latter points mentioned, as well as the easy determination of the zero and the repetition of the calibration, are advantages claimed over bridges based on the B. A. principle. We are indebted to London Engineering for the cuts and copy.

## SEARCH FOR SOLAR X RAYS ON PIKE'S PEAK.

By FLORIAN CAJORI.

EXPERIMENTS carried on by M. C. Lea* and others have failed to show the presence of Roentgen rays in solar radiation, says the American Journal of Science. If these rays reach us from the sun, their intensity must be exceedingly feeble. The suggestion has been made that Roentgen rays may exist in sunlight, but are absorbed by the earth's atmosphere. The fact that Lenard rays are stopped by only a thin layer of air made it not improbable that Roentgen rays might be stopped by a thick layer of it. On this hypothesis a mountain top is the best locality to examine sunlight for the new rays. The writer determined, moreover, to expose the photographic plate to solar rays, not several hours, but several weeks.

During preliminary experiments made in Colorado Springs, it was found that a sheet of aluminum would allow certain solar rays to pass through. These were not Roentgen rays, for the reason that black paper placed between the aluminum and the photographic plate seemed to cast as deep a shadow as did a strip of iron. A different mode of exposing the plate was necessary and a plan similar to Lea's was finally adopted.

The first 100 leaves of an unbound book were turned over, and a rectangular trough of the dimensions of the photographic plate (7·5 by 13 centimeters) cut into the next 55 pages. Seven pages above this trough, thin metallic plates, from 5 to 30 millimeters wide, were placed between two leaves and held in position by gumming the two leaves together. Care was taken to let the mucilage dry before shutting the book. After the photographic plate (Seed, 23) was placed in the trough, the book was closed, wrapped in black tissue paper, then in paraffine paper, and finally put into a tin box.

The box was prepared as follows: Its lid was placed externally over its bottom and a rectangular window, 7·5 by 13·5 centimeters, cut through them both. Thereupon a sheet of aluminum, 13 by 23 centimeters, and 0·29 millimeter thick, was placed between the lid and the bottom, so as to screen the window. The wide margin of the aluminum, lying between the sheets of tin, was united to them above and below by thin layers of beeswax. Externally the edges of the rectangular window were covered with sealing wax, to which a thin layer of paint was finally applied. A new lid was provided for the open side of the box and both lids were soldered on. Prepared in this manner, the box could be left exposed to all kinds of weather without danger that moisture would reach the photographic plate. To touch the plate, rays had to penetrate the sheet of aluminum, a few layers of paraffine and black paper, and 100 pages of the book. Roentgen rays of intensity ordinarily met with in the laboratory penetrate at once very much greater thicknesses of these materials.

Through the kindness of Mr. F. Blackmer and Mr. D. Rupp, of Colorado Springs, the box was taken to the summit of Pike's Peak (elevation 14,147 feet) and fastened by wires upon a roof sloping southward. The box was left in that position from June 27 to August 10. When subjected to the usual process of development, the plate failed to show any action of rays and presented a uniform surface, without traces of shadows from the metallic strips. Another plate, similarly exposed from July 7 to August 28 in Rosamont Park, near Pike's Peak, at an altitude of 9,200 feet, gave the same result.

Thus even in high altitudes no evidence of the presence of Roentgen rays in solar radiation was obtained.

Colorado College, Colorado Springs.

*The American Journal of Science, iv, vol. i, May, 1896, pp. 363, 364.

## THE TWO INDIAN PYGMIES IN CASTEN'S PANOPTIKUM, IN BERLIN.

HOMER tells of a fabulous race of dwarfs, the pygmies that lived in the far east, in India, and there waged constant war with the cranes. One is involuntarily reminded of this fable of the Greek poet when he sees the two tiny Indian pygmies which are now on exhibition at Casten's Panoptikum, where they constitute the "great attraction."

The two little brown skinned creatures are brother and sister. They come from the wonderland of India, Golconda, so rich in fable, and first saw light on the banks of the Irrawaddy. This is now English Burma. Unlike other dwarfs that have been exhibited in Europe heretofore, these pygmies are normally developed in mind and body; they resemble a piece of sculpture from a master hand, and as the little faces seem always to be smiling in the most friendly manner, it is easy to see why everyone is charmed with them.

THE TWO INDIAN PYGMIES IN CASTEN'S PANOPTIKUM, IN BERLIN.

They are so small and doll-like that one scarcely dares touch them.

The girl, Fatma, is sixteen years old, 25·5 inches tall, and weighs about eight pounds. Smaum, the boy, is scarcely fourteen years old; he is about two inches shorter than his sister and weighs about half a pound less. By the request of Prof. Virchow they were exhibited before the Anthropological Society on October 17, and aroused the greatest interest among those men of science, who, we are told, intend to publish a treatise on these phenomena of the genus homo.

The escort of the little people consists of the parents, Mong-Song, their father, Ma-Schima, their mother, and an eleven year old brother, Julai-en, who is of normal size. They are all of the Indo-Chinese type. A Hindostanee named Bamia acts as interpreter for the family. Besides Burmese, the language of the family, he speaks Malay and English.—Illustrirte Zeitung.

## THE INTERDEPENDENCE OF HUMAN FUNCTIONS.

By EDWIN WOOTON, F.R.G.S.I.

IT has been found possible for the mechanician to construct a machine in the likeness of man and to give to it certain motile powers. Such a machine will resist for an indeterminate time the destructive forces to whose action it is subjected; but it will have no power of adding to its substance new similar material as a substitute for that which is being removed without momentary cessation.

Inorganic material is never endowed with the power of assimilation, nor is that so endowed which once had life. This power is the one heritage held in common by all living things, and these alone. Its wording may be regarded as the only definition of physical life in harmony with all known facts.

A living cell of the human body, into whatever fixed tissue it may enter, is surrounded by irrigating channels styled "lymph spaces." These are filled with semi-plastic substance derived from the blood. The cell has a selective power, taking up only the compounds that can be utilized in its labor. It is a miniature chemical factory, but peculiar in that the energy put forth is primarily devoted to self-repair. There can be no true assimilation of an unlike element; but it must be borne in mind that the cell, though endowed with vital selective power, is subject to ordinary chemical laws, and a lethal element or compound may forcibly unite with its substance. Thus mercury is quite foreign to the human body. Of this element not the fraction of a grain has ever been found under normal conditions in man's system. Mercury is readily taken up both by cells and non-cellular plasm. Then it obtains as an albuminate. Its continued reception is absolutely inimical to organic integrity. It is an intruder, outside the exactly defined list of elements to which the organism has accustomed itself through many ages. Yet it is true that prolonged gently acting influences will modify a cell in function and structure. Even the brief period of a life may see acquired comparative immunity from the lethal power of an element or compound. Cellular destruction also is effected by chemical means. A tissue does not, unless on the body surface, wear out like a garment or an iron wheel; neither do its cells disintegrate in such a manner.

Cellular destruction in every case in which its method has been determined has been seen to be due to chemical changes. When a cell assimilates or disintegrates, the connoted chemical reactions occasion heat. Every duly nourished cell, in at least the fixed tissues, before such disintegration, generates one or more potential successors. We may regard assimilation, destruction, heat production and generation as properties common to all such cells. But every fixed cell is a unit member of some one organ or part. The functions of the organ or part are only the aggregate of the functions discharged by its cellular components.

When substitutive growth of fibrous or other tissue occurs in the lung, liver or kidney, the number of active units is lessened, and in direct proportion to the lessening is the diminution in work accomplished by the organ concerned. If it were possible to remove from the human body all varieties of tissue with one exception, the nervous, this last should present the form of man, but be white, translucent, gauze-like. The body may indeed be looked on as a nervous system clothed with other tissues. To the naked eye the brain, spinal cord and certain continuations termed nerves form the most obvious parts of that system. The essential structural elements of nervous tissue are the cell and fiber. These two terms are confusing when the fact is recalled that the former is applied to an organic unit wherever found. The "fibers," then, of nervous tissue are merely conductors of stimuli. The true cells, on the other hand, are interpreters and generators of stimuli. Into the structure of the brain, spinal cord and other connected parts which need not be specified both classes of units enter. A nerve is constructed solely of fibers.

Cellular function throughout the body generally is directly under control of the nervous system. Tissues are not endowed with their specialized activities by this system, but they are all held by it under such governance, both as to their own nutrition and the discharge of their assigned labor in the economy, that without its influence they cease to be part of the organism, lose their power of maintenance and yield their substance unresistingly to living or chemical foes.

The nervous system controls itself by the interaction of cells and loci. When any part of the body is completely deprived of its nervous supply, its functions exhaust and are incapable of renewal. It is through the control exercised by this vital governor in the highest act of consciousness, as in the simplest metabolic labor, that means are adapted to ends in the economy of the organism.

That the brain alone can experience sensation, whether pleasurable or the contrary, is common knowledge. It is by reflex action that the greater number of bodily activities are performed. The contractile tone of the capillaries is maintained by the influence of a known locus termed the vaso-motor center. When great exertion is undergone the increased blood pressure op-

presses the heart. Its work becomes too great. The stimulus to the heart causes it to contract more strongly. By such added effort it is in part able to overcome the increased resistance. But the stronger cardiac contraction does more: it transmits an inhibitory message to the vaso-motor center, a similar message is sent from the seat of resistance—the capillaries; the contractile tone of these vessels yields, they dilate, the blood passes through more easily and the heart is relieved. Again, if when the capillaries were suddenly dilated over the body surface by exposure to a high temperature, no cardiac functional modification occurred, the result would be an enormously increased tissue metabolism. When such a sudden thermal change is experienced the heart presently slows. The lessened pressure in its cavities of the passing blood transmits a message to where a nerve named the vagus has its origin, and through this nerve reflexly an inhibitory message passes to the heart, and it beats less quickly.

The cerebro-spinal nervous mass is very readily brought into a condition of partial exhaustion by any one of many differing agencies. The consideration of two will be sufficient for our purpose: overwork of muscle and of brain. Either of these will exhaust, not merely the nerve loci properly concerned with its execution, but the whole cerebro-spinal mass, from the parts concerned in ideation to those controlling the simplest bodily act. Over muscular work will lower the intellectual powers. Over mental work will produce mental atony. Any violent sensory stimulus may result in the immediate arrest of gastric digestion. Conversely, the temperate use of brain and muscle and the gentle stimulus of pleasant surroundings conduce to the due performance of all organic processes.

The principles underlying these and a host of related facts may be stated thus: The brain can be rendered consciously or unconsciously receptive of all nervous stimuli. The greater number of stimuli pass through the spinal cord; many have their normal termination in the cord. All bodily functions have their seat of governance in some one or other defined part of the cerebro-spinal mass. This last is practically one organ with many sub-centers, having each their special function. All the sub-centers appear to be beneficially influenced by the same class of food, chemical or dietetic. There is an anatomical fact that may account in some measure for the diffuse results brought about by local labor. It is this: the lymphatic vessels of the brain and cord are in continuity throughout, and communicate with two membranous canals that invest both cord and brain. These canals are filled with a peculiar non-albuminous fluid. There is thus a continuity of lymph throughout the nervous mass; and there is also an investing bath of what is certainly an allied product. Understanding as we do that lymph is cell food, it can be conceived as possible that local extravagance may have, as a primary consequence, a general lessening of supply, and, as a consequence more remote, the lowered tone of every function depending on some one or other part of the brain or cord for its execution.

"Trophic influence" was the term used generally for many years to express the controlling power of nerve structure over cellular nutrition. The old term became discarded. New thinkers declared the selfmaintaining power of all structural units. But these scientific revolutionists have been proved wrong.

In comparative physiology it is perfectly true that a cell or organism of cells may carry on all activities essential for its wellbeing without the presence of even the simplest structural nervous apparatus. That fact need not be debated, as, though frequently advanced against the "trophic" school, it is as indubitable as it is irrelevant to the conditions obtaining in man and the higher quadrupeds. Here I have no space to cite evidence, but generalizing on facts that can be tested in any laboratory, and, for that matter, by any veterinarian or surgeon in daily practice, I would say that no fixed tissue can maintain its life when due care is taken to sever its connection with the nervous system.

Muscular tissue is the medium effecting all contractile work. Without it man could not for a moment exist. The contraction of muscle is brought about by the shortening of its cellular components. Any impairment of the individual cells, or their supplanting by another tissue, can have only one primary result—lessened contractile power of the whole muscle.

The heart of man is a hollow muscle. It is a motor that for continued work demands urgently integrity of structural elements. Normally, the arteries are resilient. Under the blood pressure, laterally exerted, they dilate, and by contracting behind the wave of blood to their former caliber conserve to the blood stream the force with which it left the heart. But should these vessels be stiffened, as by senile calcification, the result to the vital muscle is disastrous. It has more work to accomplish, and endeavors to meet the demand. But the arterial calcification deprives the digestive organs of due nourishment. They, in turn, decrease their supply of material to the blood. The heart becomes insufficiently fed, is yet less able to execute the added labor—and stops.

The lungs may be regarded as membranous sacs. On the one side of the membrane is the external air, on the other blood circulating in capillaries. If a condition arose preventing the entrance of air to any part of the lungs, the presence there of blood would be useless. If, on the other hand, the capillaries were blocked, the entrance of the atmosphere could effect no benefit.

Now, the red blood cells, the capillary endothelial cells of the lung, the heart's muscle cells or fibers, and the cells of the respiratory membrane have each distinct functions; but failure of any one class of cell must result in the physiological inactivity of the others. There is absolutely no possible evasion of the law of interdependence, so far as the essential units of respiration and circulation are concerned.

Each of the three great secreting organs concerned in digestion—the stomach, liver, and pancreas—is dependent on the integrity of the others for its own efficiency. Let the stomach alone be injured. As a result, a quantity of proteids in an acid medium will pass into the intestine. The pancreatic secretion and the bile cannot digest in acid media. They could convert these proteids into peptones (diffusible albuminoids) only after neutralizing the acidity of the liquid associated with them. To effect such neutralization exhausts their digestive power. If, under such conditions of the stomach, care were not taken to insure that the food on reaching the intestine should be neutral or alkaline, the individual would starve, and the two unfairly taxed organs soon be in as deplorable a condition of incompetence as the stomach.

Free action of the bowels we have seen in a former article to be essential for removal of poisonous extractives, alkaloids, and other matters, either effete or the result of intestinal changes.

When the bile supply lessens, constipation commonly results. This constipation, by causing pressure on the abdominal veins, retards the supply to the liver of the impure blood that is (at least) the chief material whence bile is elaborated, and the primary evil is confirmed.

When in cirrhosis (drunkard's liver) the fibrous substitutive growth has advanced, the veins that bring to the liver blood from the intestinal vessels are by pressure of the fibrous growth lessened in caliber. As this organ is the great gateway through which the absorbed results of intestinal digestion should pass, systemic innutrition ensues. That, however, is a trifle in comparison with what may follow. This being that the obstructed blood vessels may allow the water of the blood to pass through their walls, resulting in dropsy of the abdomen (ascites). The accumulating exudation adding to the pressure intensifies the mischief. Has such a process as this any relation to cardiac action? An immediate and very forcible relation. The obstructed blood retards the general circulation. The heart, being a sensitive muscle, responds to the stimulus of the increased capillary pressure and hypertrophies. A relation is borne by the morbid process to the respiratory function. The pressure of the ascitic fluid in the abdominal cavity prevents the free expansion of the thorax. Also the blood circulates feebly in the lungs.

The kidneys are the chief poison excreting organs of the body. Failure of their nutrition results in changed cellular structure. When this condition has been established there is lessened excretion of nitrogenous waste. What must follow the retention of this in the blood we have seen in a former article. Never can a single factor in the maintenance of the body's health be impaired without all such factors being sooner or later affected. And any disorder of an organ vital in the economy must act on the units of the nervous system, and then—the muscles are wearied, the retina is less receptive, taste is less keen, the intellect is dull, nothing seems right; for a fair reason, too—everything is wrong.

If a barrow full of stones be thrown among delicate machinery, the result may be either the elimination of the stones or the smashing of the engine. The varied parts of the mechanism have not to make themselves out of the stones. But in a self-poisoned body the cells have to attempt the assimilation of matter that is incompatible with vitality. The animal body may be likened to a number of laboratories in one factory. Each laboratory has its own class of work, but the output from each travels the factory round. A single error will be productive of others, and the accomplished industrial result will be worthless. The analogy is rough, for vital action stands alone, truly incomparable with aught else.—English Mechanic.

## ARTIFICIAL DIAMONDS FROM STEEL.

THE diamond, as well known, is carbon crystallized in an octahedral form. In order to obtain artificial diamonds, pure carbon must be fused and allowed to cool under a high pressure. The recent studies of scientists have proved this conclusively, although the means of establishing the conditions of fusion and pressure have not been clearly determined.

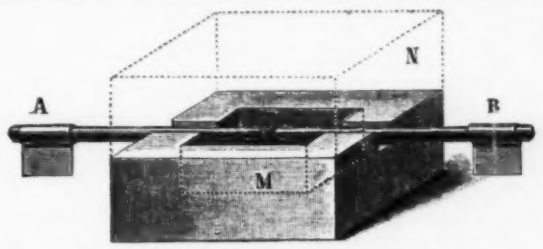



FIG. 1.—MOISSAN'S ELECTRIC FURNACE.

In making a chemical analysis of meteoric stones, there has been found in the iron composing the aerolites that fall upon the surface of the earth certain substances that are insoluble in strong acids and that contain microscopic diamonds. This important fact has been demonstrated by Messrs. Weinschenck, Brezina, Cohen, Kunz, Huntington, König, Foote and Maillard, and more recently and in an absolutely scientific manner by Messrs. Friedet and Moissan, at Paris, who have demonstrated the presence of diamonds of very small size in the famous meteorite of Cañon Diablo.

FIG. 3.—METEORIC IRON.

FIG. 2.

Moissan, in taking these facts as a basis, endeavored to fuse carbon in iron at a high temperature and afterward cool it under a high pressure. To this effect he heated iron to 3,000° in a carbon crucible placed in an electric furnace of his invention (Fig. 1). The iron in fusion was saturated by porous carbon obtained through the calcination of sugar in a close vessel. The sudden cooling of the external part of the fused material brings about the formation of a very tough shell, and the internal part cools under the action of a strong pressure, the specific weight of molten iron being greater than that of the metal in a solid state.

Upon dissolving the iron thus obtained in acid, Mr. Moissan got crystals of artificial diamonds, which did not, it is true, exceed half a millimeter in diameter, but which had all the properties of the natural stones (Fig. 2).

In the section of public instruction at the National Swiss Exposition some photographs of microscopic diamonds were exhibited in the department assigned to the University of Berne. Prof. A. Rossel, in taking the above mentioned facts as a basis, endeavored to ascertain whether or not certain very hard kinds of steel, as well as the equally tough iron derived from the bottom of blast furnaces, where certain parts of the metal are submitted to a very high pressure, contain microscopic diamonds.

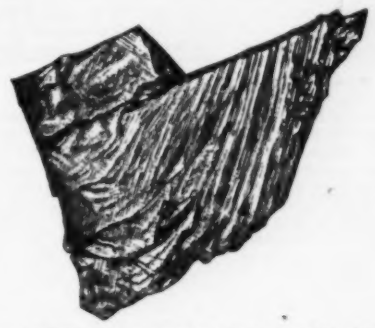


FIG. 4.—ARTIFICIAL DIAMOND FROM STEEL. (× 250.)

Upon treating certain metallic parts distinguished by their physical properties with concentrated nitric and sulphuric acids and hydrochloric and fuming sulphuric acids and fused chlorate of potash in succession, Prof. Rossel actually succeeded in ascertaining the presence of diamonds in steel, that is to say, of microscopic particles which, when examined with the greatest care, are found to possess not only the property of crystallizing in octahedral form, but to exhibit all the physical qualities that distinguish natural diamonds from all other mineral substances.

FIG. 5.—ARTIFICIAL DIAMOND FROM STEEL. (× 250.)

Prof. Rossel's discovery gives us a glimpse of a new method of analyzing iron in order to determine its properties, and of manufacturing very hard varieties of steel, and, at the same time, proves the possibility of obtaining artificial diamonds of a larger size one of these days. Up to the present the diamonds obtained (Figs. 4, 5 and 6) do not exceed half a millimeter.—Journal Officiel Illustré de l'Exposition Nationale Suisse.

FIG. 6.—ARTIFICIAL DIAMOND FROM STEEL. (× 250.)

## SECOND SIGHT.

By Judge JAMES BARTLETT.

SOME of the most surprising effects of modern magic are produced by the simplest means and apparatus. The old fashioned robe embroidered with cabalistic figures, ample enough not only to envelop the figure of the performer, but an ordinary packing trunk full of other things besides, the table beneath which you

could not see because of the heavy cover of black velvet that fell in sable folds to the floor, and all the paraphernalia of boxes and vessels of different sorts have disappeared, given place to ordinary evening costume and ordinary furniture, selected with special reference to the apparent impossibility of its use as a receptacle or storeroom for objects the performer wishes to conceal from his audience. Some of the easiest and simplest of modern tricks, that any one with little or no practice can perform, are very effective. Here, for instance, is one which, so far as I know, is entirely new, and yet appears to be identical with that claimed to be performed by preternatural means by occultists who profess to have studied magic in India.

The trick is performed as follows: Each person in the audience is presented with a slip of paper, upon which to write anything he or she may choose. The paper written upon is immediately secreted by the writer, as much care as possible being taken that no one else sees what is written upon it. The performer, who has been absent from the room while this is being done, is brought in and led as if in a state of trance to a chair within full view of every one present. A light piece of drapery is thrown over him so that he is completely covered by it, and yet it is thin enough to be translucent, and if can be seen he has not gone down through the floor or ascended up through the ceiling. The audience is told the drapery prevents the sphere or influence or spell that surrounds him from being dissipated. He now begins and repeats, word for word, the sentences written upon any or all the slips of paper. Nothing can be more astonishing; the paper has not left the possession of the writers; it is equally certain that it is impossible that another person could have seen what was thereon written, and yet the trick is as simple as it is surprising, and that is certainly saying a great deal.

The explanation is as follows: In order to write anything upon the slip of paper given out, one must have something firm and flat upon which to place it, and for this purpose bits of pasteboard of a convenient size are handed about the audience. The pasteboard, however, is not solid, as it seems to be; the uppermost layer of paper can be separated at one of the edges from the layers beneath it, and into this slip white paper introduced. The uppermost layer of paper is blacked with crayon or soft pencil on its under side, and whatever is written upon the paper resting upon it is faithfully stenciled or traced upon the white paper inserted. The pasteboards, being collected, are taken out of the room and given to the performer by his assistant, who may or may not be a confederate. That is, if the performer is very skillful, he may dupe his assistant as well as his audience. He may tell him, for instance, it is necessary for him to have these pasteboard rests and pass his fingers over them so that he can become en rapport with the person with whom they were in contact. It is better, however, at least at first, to have a confederate. The rest is easy enough. The inserted slips of tell-tale papers are collected and carried with him by the performer, who manages to read them either through a hole in the drapery or by the light that sifts through it as he sits covered up in his chair with his back to the audience. It is well, sometimes, not to have enough pasteboard cards to go round the audience, and give apparently at haphazard a book, an atlas or portfolio, which, of course, has been neatly covered with paper or cloth and supplied with blackened and with white paper as are the pasteboard cards.

If anything should happen that would prevent reading any particular strip of paper, the performer may at once say that he does not pretend to be able to read all, but only such sentences as appear to his mental vision. This will add to the effect and make the trick appear all the more mysterious. In supplying pencils to your audience be sure to give them good, hard ones, that will require some pressure to make the writing legible; be careful, too, that the paper with which you furnish them is rather thin, so that you will get a good tracing on that you have inserted in the pasteboard rest. As each slip is read by the performer the assistant should ask if any one in the audience wrote that sentence and if it is correctly repeated, and then, stepping to the writer and taking the slip from him or her, he should himself read it aloud and show it to any one desirous of seeing it; this enhances the wonder and interest of the performance, and also gives the performer time to decipher the next slip. It is well to have the sentences take the form of questions which the performer can read, comment upon and answer in an oracular way, especially as this takes up time and consequently gives fewer selected slips to read during the period allotted to the trick, for to read a few is quite as wonderful as to read many.

Now let the master of occult art cap the climax. Let him again be led from the room, ostensibly to have his magic sphere renewed, and let some one among the audience write the name of a deceased person, together with their own, on a slip of paper. Lay a good deal of stress on the requirement that the names shall be those of a person deceased, this, of course, being only to mystify the audience. When the names have been written the performer is to enter the room. He does so with the sleeve of his coat rolled up, and his arm bared to the elbow. After showing there is nothing upon his arm he turns down his sleeve, readjusts his cuff and proceeds with his trick. He first names the person whom the audience has chosen, in his absence, to write the name; he requests that person to crumple up the slip of paper upon which the name is written and rub it well over his arm just above his cuff, "so that the writing will penetrate through his sleeve," he says; now turning up his sleeve he shows the writing that was upon the paper in blood red letters upon his bared arm. The manner of performing this part of the trick is, having ascertained, as before, the writing upon the slip of paper by means of the tracing, to write or print it with red ink mixed with a little glycerine, or red printer's ink, or oil color and turpentine, upon paper which is to be fastened on the inside of that part of the performer's coat sleeve which he instructs the person who has written the name upon the paper to rub with the paper. The paper may be neatly pinned to the lining of the sleeve, care being taken that the pins do not scratch when the sleeve is turned down.—Popular Science News.



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